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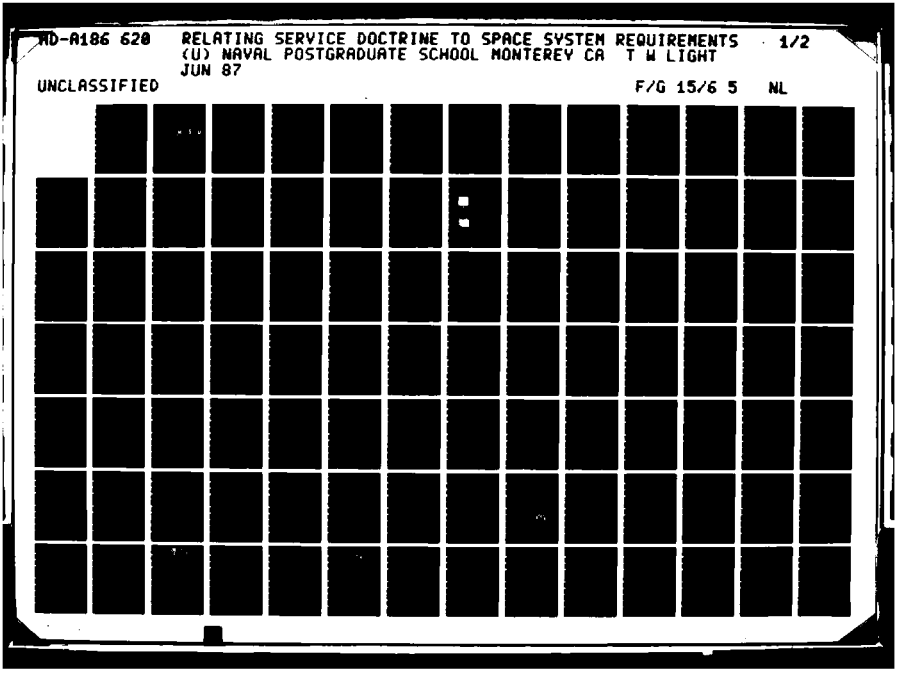

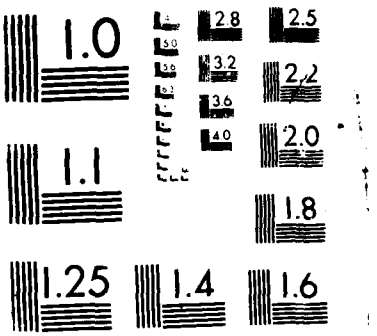

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THESIS

RELATING SERVICE DOCTRINE TO
SPACE SYSTEM REQUIREMENTS

by

Thomas W. Light

June 1987

Thesis Advisor — Allen E. Fuhs
Co-Advisor — Carl R. Jones

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19 ABSTRACT

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Relating Service Doctrine to
Space System Requirements

by

Thomas W. Light
Captain, United States Army
B.S., Georgia Institute of Technology, 1977

Submitted in partial fulfillment of the
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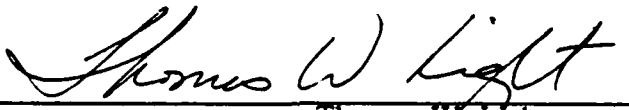
Author: 
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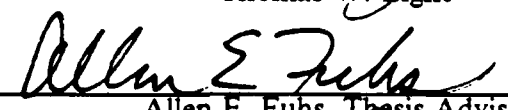
Approved by: 
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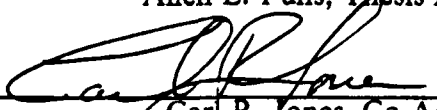
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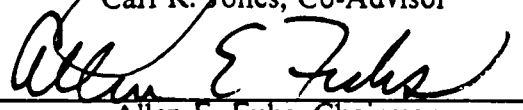
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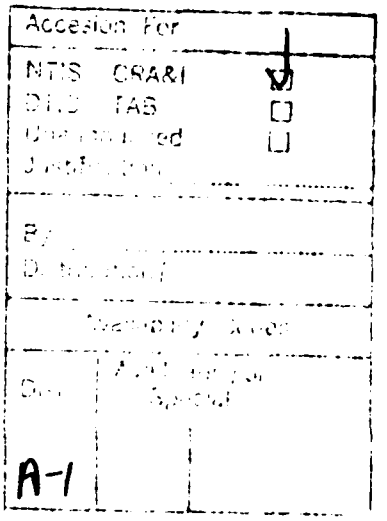
ABSTRACT

The objective of this thesis is to demonstrate a method of relating doctrine to requirements when considering space concepts. Service members must evaluate solicited and unsolicited proposals from contractors, consider the advantages of space, and then relate the advantages of space to the overall context of the proposed space system working within current and future military organizations. To perform these tradeoffs requires a strong foundation in how the services plan to operate in the next conflict; the AirLand Battle and Maritime Strategy provide this strong foundation and will be examined. The Army's Concept Based Requirements System (CBRS) relates doctrine to requirements; it will be described as a recommended method for determining joint requirements. To illustrate how CBRS will operate when considering joint space requirements, the concept of a space-based laser designator is explored.



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My thanks also go to my wife, Sandy. She had to tolerate my mood changes which reflected my progress (or lack thereof) at various stages of the thesis. She did so with remarkable good-humor and patience.

I. INTRODUCTION

A. GENERAL

The Advisory Group for Aerospace Research and Development (AGARD), an organization of the North Atlantic Treaty Organization (NATO), held a symposium at the National Aeronautics and Space Administration's (NASA) Langley Research Center in 1983 ; the title of the conference was **Space System Applications to Tactical Operations.** In his keynote presentation General Craig, the Air Force's Deputy Chief of Staff for Requirements, observed the following:

> From a tactical standpoint the most challenging aspect of seeing a new frontier develop is to ensure space information and services remains compatible with existing frontiers. That is what we have had to learn to do successively as we moved from land - to the sea - and into the air in the past. Similarly, it is critical that we as nations of the alliance stand shoulder-to-shoulder -- so that our forces can INTEROPERATE effectively in the future just as we have worked hard to have them do that today. . . . A new frontier does not mean there is more money available, it just means there is more competition for programs in the budget. The measure of merit must remain one of determining the contribution expected of new systems. [Ref. 1: p.4-3]

It is the purpose of this thesis to follow General Craig's guidance. By analyzing joint service doctrine, new ways of performing common missions will be examined. The common missions that will be examined in detail are those of long range engagements--a generic term used to describe the Army's deep battle, the Air Force's interdiction, and the Navy's over the horizon missions. From that basis, space support to those areas will be reviewed. To illustrate a method for analyzing new space applications, the idea of a space-based laser to designate targets will be explored.

Concept exploration requires people to look at traditional methods of performing missions and then project how a new idea might fit in. There must be a way of separating "good" ideas from "bad" ideas. "Good" may be low cost, high performance, or a combination of these which tries to establish the value of the idea. Multi-Attribute Utility Theory (MAUT) and other weighting schemes of these goals seek to assist decision makers in this process. The weighting really depends on the orientation of the decision maker who has the ***authority*** to pass judgement on the concept, assuming there is only **one** decision maker.

It is the purpose of this thesis to illustrate a method for relating doctrine to requirements. The method is illustrated by an example; the example is a space-based laser designator. No attempt is made to trade the idea of a space-based laser designator with others which would accomplish the same mission. An unbiased analysis allows determination by the decision maker of the contribution expected of new systems as they relate to traditional methods of performing that mission.

B. THE CURRENT CLIMATE FOR TACTICAL SPACE SYSTEMS--A WINDOW OF OPPORTUNITY

One of the forgotten dimensions in the military procurement process is historical and political timing. An idea whose time has not come will not be funded. Windows of opportunity sometimes open which will allow superior concepts the chance of fruition; they also allow substandard concepts to be thrust forward without adequate examination. It is essential that concepts be well-defined and articulated before windows of opportunity open.

The services currently use space assets to enhance their ability to perform their individual missions. Space is a very expensive place to operate [Ref. 2: p.7], and the military must be attuned to the historical and political windows of opportunity that may open the way for other superior concepts to surface. Space support of **joint tactical operations** is one area where the author believes the window may be opening more widely. The following facts help to illustrate this statement.

Military space systems currently deployed appear to be designed to support strategic operations. The bulk of these missions are assigned to the Navy and Air Force since they support the nation's nuclear TRIAD (Bombers, Submarines, Intercontinental Ballistic Missiles). A committee of the Army Science Board examined the Army's utilization of space in 1984 and concluded that the Army was only a minor user of available space systems with limited influence in the design and operation of the systems [Ref. 3]. This was concluded even though the Army currently participates in the Tactical Exploitation of National Capabilities (TENCAP) program and has done so actively for the past decade. As a result, an Army Space Initiatives Study (ASIS) was undertaken, and an Army Space Policy was established by the Army's Secretary and Chief of Staff in June 1985. The policy states:

> Consistent with National and Department of Defense policies and in cooperation with other Services and agencies, the Department of the Army will exploit space activities that contribute to the successful execution of Army missions. The

> Army supports assured access to space and will use space capabilities to enhance the accomplishment of **strategic, operational, and tactical missions.**
>
> . . . Army plans and evolving space architecture must capitalize on **national and joint programs,** preserving options to support initiatives that fulfill Army requirements. [Ref. 4]

The Army's emphasis in the space policy on joint operations and the inclusion of the tactical dimension to the employment of space systems found its way into the new Department of Defense Space Policy. After the space shuttle Challenger accident and the White House decision to restrict shuttle launches [Ref. 5], the old 1982 space policy was in need of revision. A working group including the Air Force, Navy, Army, Joint Chiefs of Staff, and Strategic Defense Initiative (SDI) organization completed a draft of the revision in December of 1986. Army and Marine Corps interest in satellite imagery of the local and regional tactical situation influenced the call for an expansion of capability in the areas of space-based intelligence and surveillance. A key theme throughout the draft policy was how U.S. military space systems were becoming a more integrated part of U.S. military operations. The Army and Marine Corps insisted that their needs for **tactical support** were integrated into the new policy. [Ref. 6]

While the Defense Department was examining its future role in space, the Senate was examining its own role and that of the Defense Department organization to meet national defense objectives. Under the leadership of Senators Barry Goldwater and Sam Nunn, the Senate Armed Services Committee published a report entitled *Defense Organization: The Need for Change* on 16 October 1985. The principal organizational goal of DoD is defined in the report as:

> . . . the integration of the distinct military capabilities of the four Services to prepare for and conduct effective **unified operations** in fulfilling major U.S. military missions. In this study, this goal is termed **"mission integration".**
>
> . . . Effective mission integration is critical to U.S. national security because none of the major missions of DoD can be executed alone by forces of any single Service. [Ref. 7: p.2]

The study further sites deficiencies caused by limited mission integration at DoD's policymaking level. Some of the deficiencies, quoted from the report, include:

- In colloquial terms, materiel inputs, not mission outputs, are emphasized.
- A sharp focus on missions, where DoD must compete with potential adversaries, is lost in the functional diffusion.

- Functions (e.g., airlift, sealift, close air support) which are not central to a Service's own definition of its missions tend to be neglected.
- Tradeoffs between programs of different Services that can both contribute to a particular mission are seldom made.
- Opportunities for non-traditional contributions to missions (e.g., Air Force contributions to sea control) are neither easily identified nor pursued. [Ref. 7: p.3]

The Department of Defense Reorganization Act of 1986 (known as the Nichols-Goldwater Act) was approved by the committee on 6 March 1986. Two major features of the act provides for:

- The Chairman of the Joint Chiefs of Staff to assess joint military requirements for acquisition programs and develop joint doctrine. [Ref. 8: p.3]
- The Congress to reduce the burden of congressional micro-management on the Defense Department and reinforce the DOD organizational changes in the bill by shifting the focus of Congressional oversight away from resource inputs to mission outputs and from Service-unique programs to joint missions and programs. [Ref. 8: p.8]

The elections in 1986 shifted control of the Senate to the Democrats and propelled Senator Nunn to the chairmanship of the Armed Services committee. In implementing the new focus directed by the reorganization act, he announced proposed changes in the subcommittee structure. His restructuring plan involved elimination of the military construction panel and creation of a new panel to oversee Tactical Warfare issues. The Sea Power and Force Projection subcommittee will be renamed the Projection Forces and Regional Defense subcommittee under the plan. Chaired by Senator Edward Kennedy, the panel will concentrate on areas where the United States does not have substantial forces deployed and must depend on sea control and maritime force projection when military might is needed. The panel also will have responsibility for reviewing requirements of low-intensity conflicts where special operating forces are needed. The changes would shift the emphasis of four of the committee's six panels from a functional orientation involving budget review to a mission orientation with a broader look at what the military needs to meet threats and commitments. [Ref. 9: p.6]

The medium of space provides the Armed Forces with several advantages that transcend service boundaries. It appears to the author that the historical and political events of 1985 and 1986 may have opened the window for consideration of space systems which are designed to support joint tactical operations. The recent decisions

to form a J7 for doctrine and a J8 for acquisition within the Joint Chiefs of Staff (JCS) recognizes the need for emphasis in these two areas [Ref. 10]. It may also indicate that much work needs to be done to define exactly what is the joint doctrine for performing missions and how that relates to the requirements for systems which will support that doctrine. Because of the expensive nature of space systems, the services can no longer expect to rely solely on internal service support for meeting their own space needs. The key to winning approval of Congressional funding for space systems in the future will be **the articulation of joint military requirements** and **showing the relationship of these requirements to the accomplishment of unified missions** during the Planning, Programming, Budgeting, and Execution (PPBE) cycle.

C. OBJECTIVE

The objective of this thesis is to demonstrate a method of relating doctrine to requirements when considering space concepts. Service members charged with the responsibility to provide doctrine, training, organizations, and materiel for defending the country must act as "honest brokers"; they must evaluate solicited and unsolicited proposals from contractors, consider the advantages of space, and then relate the advantages of space to the overall context of the proposed space system working within current and future military organizations. To perform these tradeoffs requires a strong foundation in how the services plan to operate in the next conflict. Doctrine provides this strong foundation and will be examined to provide a frame of reference. There currently exists a method within the Army to relate doctrine to requirements--it is called the Concepts Based Requirements System (CBRS). It will be described as a recommended method for determining joint requirements. To illustrate how CBRS will operate when considering joint space requirements, a space-based laser to designate ground targets will be examined.

D. SCOPE AND LIMITATIONS

The "umbrella" statements of the services' doctrine are, by design, very broad. The basic features of these concepts will be covered. However, the scope of this thesis will narrow to the portions of these concepts dealing with deep operations and the Joint Attack of the Second Echelon (Army and Air Force) and Over-the-Horizon operations (Navy and Marine Corps).

In an effort to promote general understanding and discussion of the ideas of tactical space support, the thesis is unclassified. As a result, some areas may appear imprecise; this is a result of this self-imposed limitation.

The audience for the thesis are ***not*** those already familiar with space systems and their missions. It is intended to generally acquaint civilians and military people in service doctrine and space applications. Every effort has been made to keep the discussion brief enough to encourage reading instead of stacking this document.

E. ORGANIZATION OF STUDY

The ***Method for Determining Requirements*** chapter will discuss the reason doctrine should be studied in the first place and will examine the Concepts Based Requirements System (CBRS). CBRS relies on having a doctrinal base to provide the context for considering solutions to deficiencies. ***AirLand Battle and the Maritime Strategy--The Foundation for Joint Operations*** provides the context in the following chapter. The focus will then narrow in this chapter to long range engagements as they apply to the Army and Air Force's deep operations and the Navy and Marine Corps' over-the-horizon operations. Comparisons will be made of the basic tenets, methods, and resources of the services' doctrine on performing these operations to highlight joint ideas. From this context, ***An Example of the CBRS Process*** will be presented in the next chapter. The sections of this chapter will parallel four elements of the CBRS process and will demonstrate the use of the method on a space-related problem. The example chosen is a space-based laser to designate ground targets for attack. The ***Conclusions and Recommendations*** chapter will highlight the key points presented throughout the thesis.

II. METHOD FOR DETERMINING REQUIREMENTS

A. WHY STUDY DOCTRINE?

The doctrine of the services might be called a form of "codified wisdom".[1] The principles of war and other varieties of guidance for employing military forces are not proven scientifically. The scientific method provides for identifying a problem, formulating hypotheses to correct the problem, and designing experiments to test the possible solutions. It is certainly not desirable to start a conflict to establish whether a principle of warfare is valid or invalid. The establishment of a bedrock foundation on which to base employment and acquisition decisions is, therefore, difficult to prove.

The services do study historical precedents, form models to think about operations, and attempt to formulate principles which transcend environmental considerations. The attempts to do these functions can be labeled in a number of ways: strategy, doctrine, tactics, etc. These labels are important and their meanings will be explored later. The common element, however, is the **attempt to articulate a foundation** upon which to build forces capable of defending the country. The definition of a foundation is an important endeavor so long as wars continue to be fought. It's the starting place for placing in context how the war will be fought to achieve political objectives, how missions will be accomplished, and the interaction of forces which will fight it. It provides the basis to answer the challenge issued by Senator Barry Goldwater, then-Chairman of the Senate Armed Services Committee, in a speech to the Senate on 4 October 1985:

> . . . The right problem is the integration of our forces to accomplish *missions* and the right question is how to do it [Ref. 11: p.25].

This chapter explores the link between doctrine and the integration of new systems. The Army's Concept Based Requirements System (CBRS) will be explained in detail. The importance of understanding different service terminology will be emphasized. Two recently examined methods for analyzing service requirements and Command and Control (C2) systems will be compared with the CBRS.

---

[1]This term borrowed from Professor Carl Jones, Professor at the Naval Postgraduate School.

B. THE CONCEPTS BASED REQUIREMENTS SYSTEM (CBRS)

1. History

The idea of a mission approach to resource allocation goes back at least to the Congressional Budget Act of 1974. The act stipulates that the President's budget be displayed in terms of agency missions. Later, the Office of Management and Budget (OMB) promulgated Circular Number A-109 (5 April 1976) requiring that any proposed new major system acquisition be preceded by an analysis of the mission and the formulation of a mission needs statement. In turn, the Office of the Secretary of Defense (OSD) published a series of directives, 5000.1 and 5000.2 being among the most important, to meet this requirement; the research and development community, under the leadership of the Under Secretary of Defense for Research and Engineering (USRDE), also formulated a mission structure (a listing of missions) to meet this requirement. The Army's Training and Doctrine Command (TRADOC) was then tasked by the Department of the Army headquarters to conduct Mission Area Analyses (MAAs) for the Army in response to the same OMB requirement. It is from this historical background that the process known as CBRS has evolved. [Ref. 12: pp.1-2]

The MAA process is a detailed application of the Concept Based Requirements System (CBRS) process. The MAA focuses on Army battlefield missions in determining deficiencies and corrective actions for the purpose of influencing resource allocation. The fundamental logic of MAA investigates the required battlefield tasks, their frequency of occurrence, the conditions under which they must be performed, and the standards which constitute acceptable task accomplishment. The different MAA battlefield mission areas are indicated in Figure 2.1 [Ref. 12: p. C-2] and are derived from a "capstone" concept of how the Army intends to fight. The responsible organization for performing each of the MAAs is called a proponent. [Ref. 12: pp.C2-C6]

A study was performed by two students at the Industrial College of the Armed Forces to examine the Army's method of determining its requirements. The study was requested by the Program Analysis and Evaluation office of the Office of the Secretary of Defense. [Ref. 13: pp.1-2] The study concluded:

- The CBRS process results in detailed documentation which can be widely disseminated to keep field users informed of the progress being made toward establishing specific requirements.

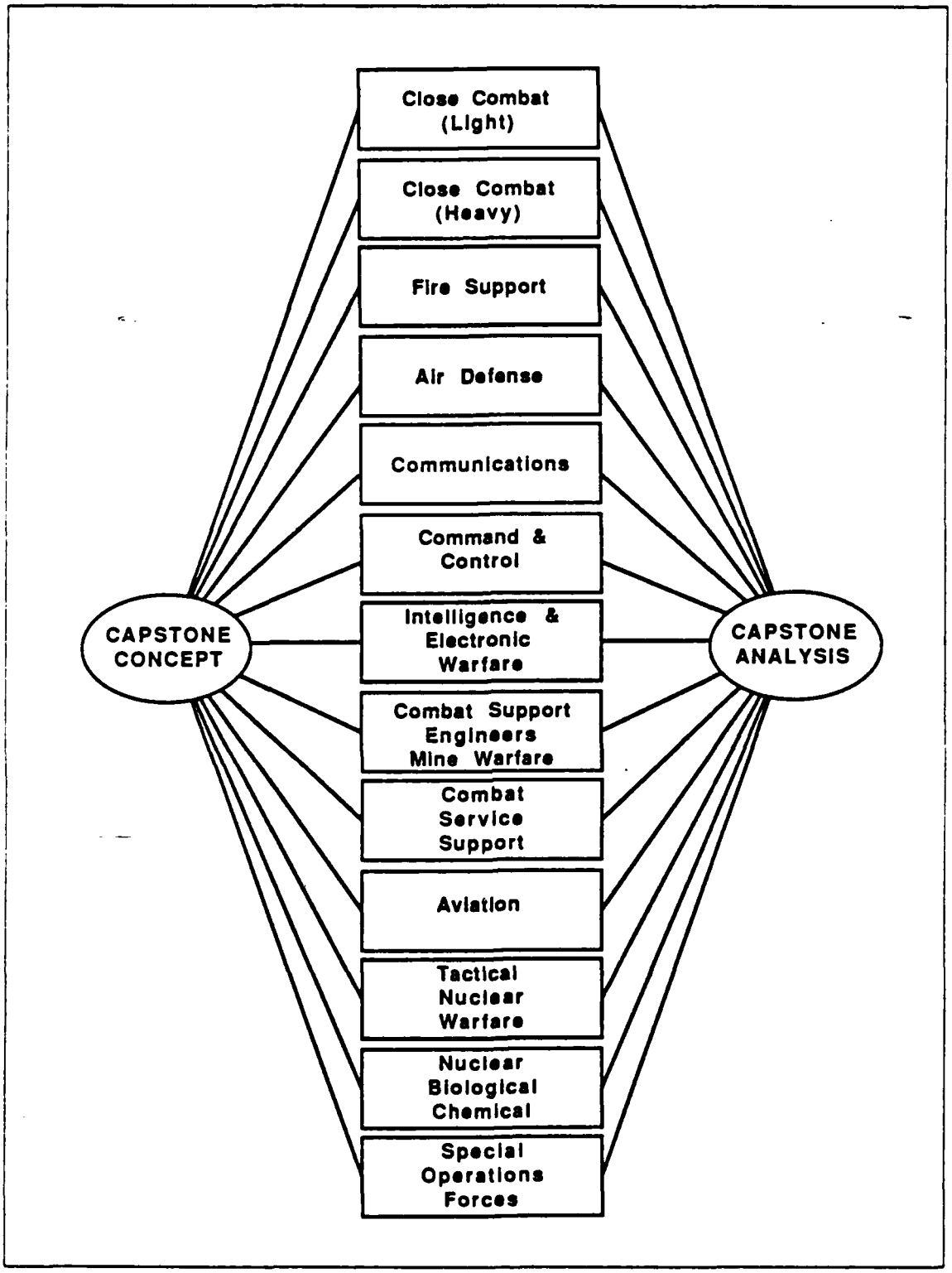

Figure 2.1 Battlefield Mission Areas.

- The process can be used to substantiate specific requirements if they are called into question during the extensive review process leading to DSARC (Defense Systems Acquisition Review Council) I, II.[2]
- The other armed forces should evaluate the Army requirements determination process to determine whether it would improve their processes and whether the improvement would justify the commitment of additional resources. [Ref. 13: pp.49-50]

These results might not seem as significant if the study had been performed by Army officers. The students who performed the analysis, however, were a Navy Captain and Marine Corps Lieutenant Colonel with extensive experience in materiel acquisition for their respective services [Ref. 13: p.2]. The following section is a description of the process recommended by this study.

2. **Description**

The process known as CBRS is shown in Figure 2.2 [Ref. 12: p.C-30]. CBRS is defined as:

> The process for determining the Army's warfighting requirements through the development and analysis of operational concepts [Ref. 14: p.Glossary-4].

The Army builds the system around four major areas:

- Missions
- Historical Perspectives
- Threat
- Technology Forecasts

The concept exploration phase of this system is a form of "informed speculation". By analyzing the future threat the Army may face on the battlefield, a projection is made on the type of ***missions*** that the Army may be called upon to perform in this environment. Total battlefield missions, tasks, and subtasks are broken down on a functional basis to identify where each mission area analysis should "plug in", or have an active role. This framework for integrating the different MAAs is referred to as the "Battlefield Mission Taxonomy" and is shown in Figure 2.3 [Ref. 12: p. C-5].

The ***historical perspective*** seeks to establish part of a foundation to look at how missions were executed in the past, operational difficulties experienced, and ways to implement better solutions in the future. History provides the experimental evidence

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[2]As a result of recommendations made by the Packard Commission, the DSARC was eliminated and replaced by the Joint Requirements Management Board (JRMB).

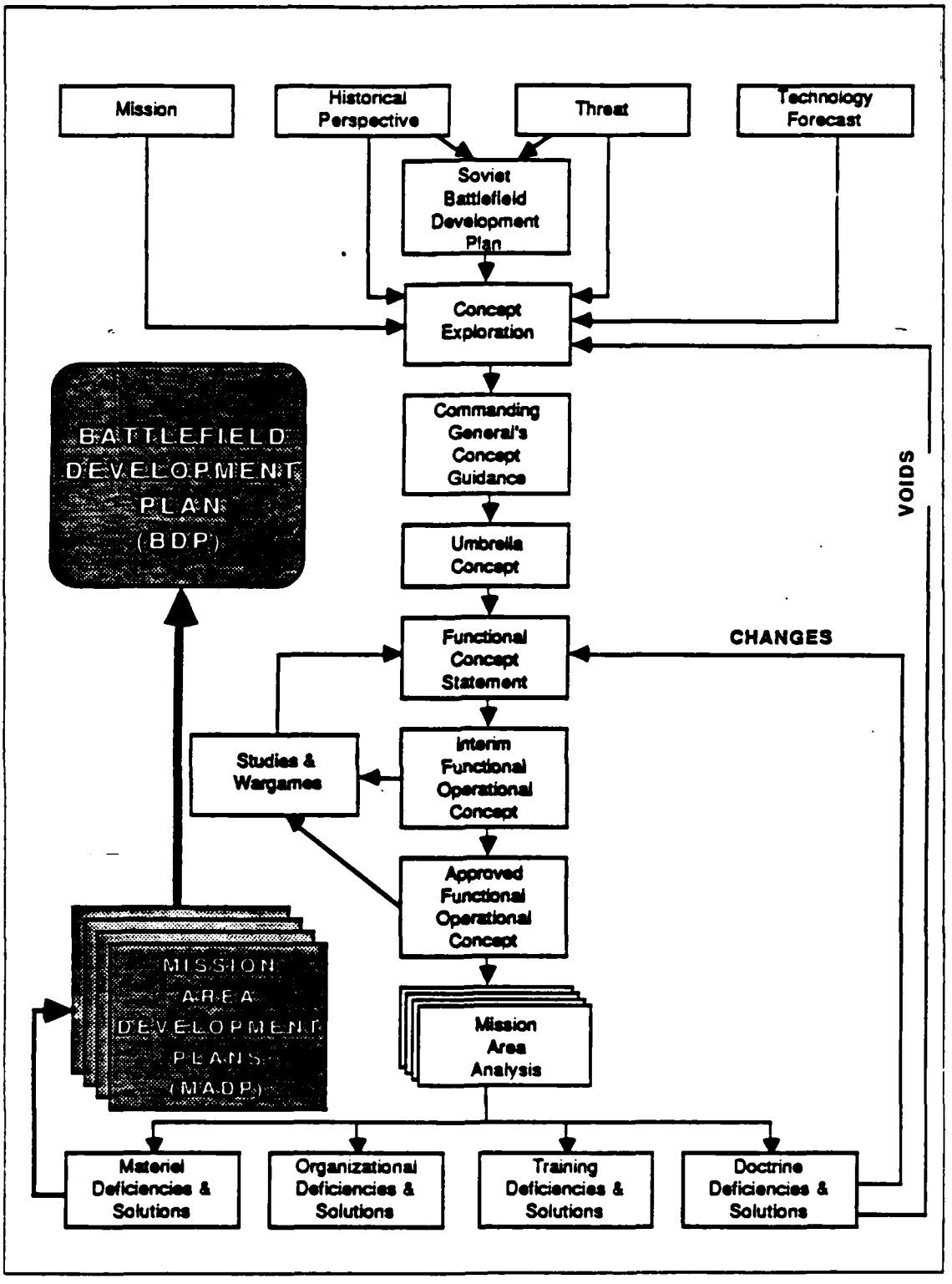

Figure 2.2 The Concepts Based Requirements System (CBRS).

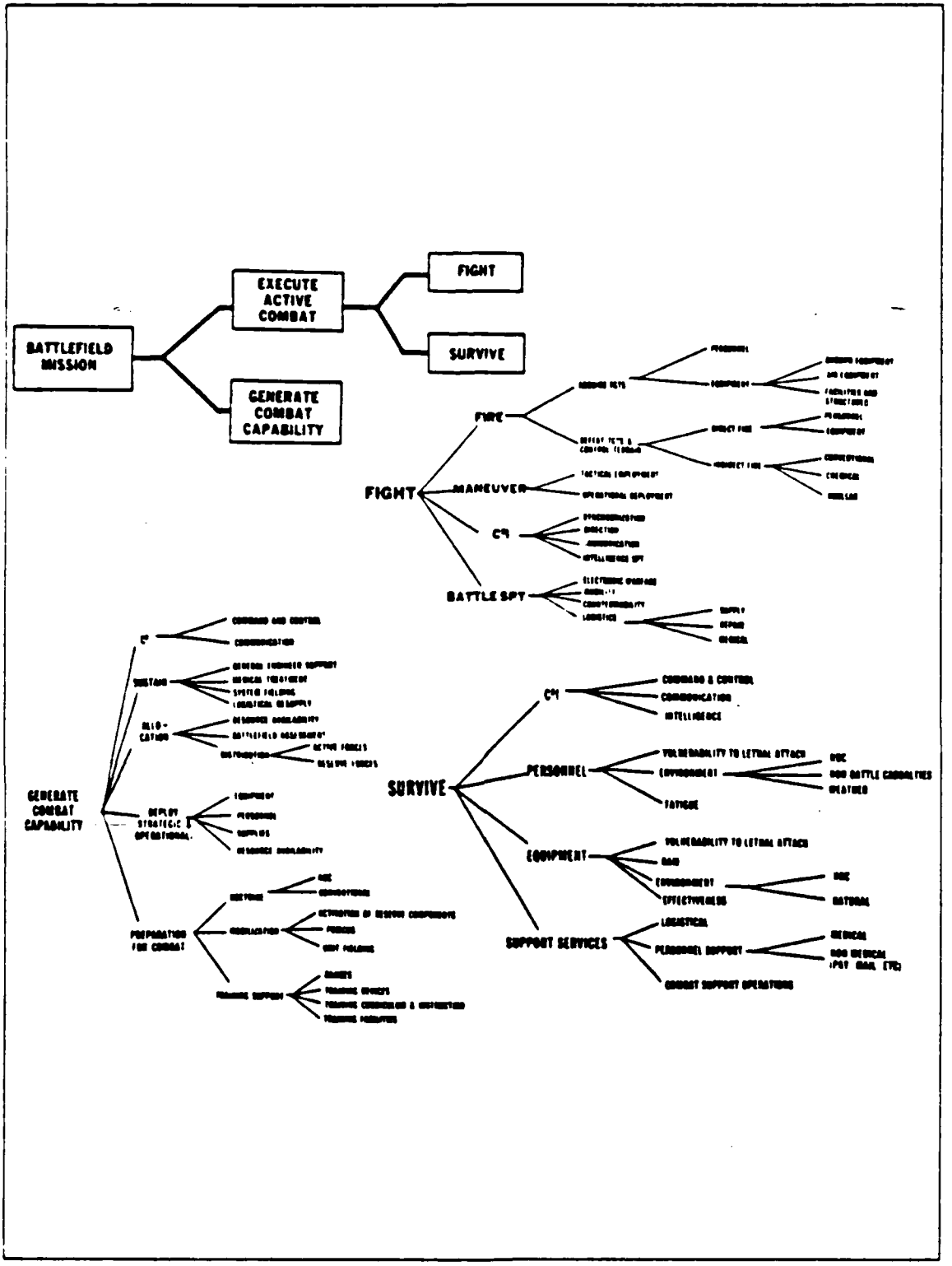

Figure 2.3 Battlefield Mission Taxonomy.

to substantiate or reject principles to guide future military operations. Research done by Hazlewood as cited by Joseph Wohl in an article on ***Force Management Decision Requirements for Air Force Tactical Command and Control*** indicates:

> Crisis management may be improved simply by providing more systematic information on past crises that had many of the same characteristics [Ref. 15: p.629].

The ***threat*** assessment is a critical element of each MAA. The identification of deficiencies within mission areas is based on projections of threat force doctrine, tactics, organizations and equipment. The threat used for evaluation must be standardized to obtain consistency between and within different MAAs and must be projected with the highest possible degree of accuracy. Threat forecasts should project out to a minimum of five or more years past the last Program Objective Memorandum (POM) outyear, since the proponent is faced with an eight to ten year materiel acquisition cycle for a "new start" program. To facilitate this, the Army intelligence community has developed and keeps current the following threat documents:

- Soviet Battlefield Development Plan (SBDP), prepared and updated annually by the intelligence community under the direction of the Army Chief of Staff, Intelligence (ACSI).
- Army Regional Threats (ART), which are expansions of selected portions of the SBDP. They will be prepared for Europe, Southwest Asia, and Korea by the Intelligence Threat Analysis Center (ITAC) of the Intelligence and Security Command (INSCOM).
- Threat Assessment for Mission Areas (TAMA) data base, prepared and maintained by TRADOC, provides threat data used for all computer analysis and wargaming done in TRADOC. [Ref. 12: p.C-8]

Technology forecasts provide a means for a dynamic force to do more than react to past and current threats. The advance in military capability must keep pace with the advances in science if forces are not to become obsolete. All military forces today have a technological base; therefore, even where a specific deficiency is not identified in a mission area, **the technological opportunities to strengthen a mission area are explored** which could provide significant leverage to U.S. forces or to potential adversaries. [Ref. 12: pp.C20-C21] Using the best technology available gives the Army the capability to compensate for a marked numerical advantage the enemy may possess and provides adequate direction to the technological community to stimulate their research in the direction of future concepts. [Ref. 13: pp.8-10]

Concepts evolve from considerations of missions, threats, history, and technology using this process. Utilizing the ***Commanding General of TRADOC's (CG) concept guidance***, a "capstone" or ***umbrella concept*** emerges to guide current and future developments. AirLand Battle and Army 21 (formerly called AirLand Battle 2000) are outputs of the Concept Based Requirements System. AirLand Battle furnishes the authoritative foundation for subordinate doctrine, force design, materiel acquisition, professional education, and individual and unit training in the present; Army 21 evolved from AirLand Battle and does the same for future systems [Refs. 16,17: pp. i,9].

It is important at this juncture to explain what ***operational concepts*** are:

> Operational concepts provide emerging Army, joint, or multiservice doctrine that describes battlefield capabilities for combat, combat support, or combat service support operations for the mid term or far term. (Mid term is two to seven years; far term is seven years and beyond.) Operational concepts are published in TRADOC 525-series pamphlets.
>
> As implementation of operational concepts becomes feasible with fielded or budgeted resources, these concepts must be refined into tactics, techniques, and procedures. Therefore, ***publication of a new TRADOC 525-series pamphlet constitutes a directive*** to include the concept, when applicable, in field circulars, field manuals, training circulars, programs of instruction, and Army Training and Evaluation Program mission training plans. [Ref. 14: pp.2-1 thru 2-2]

The purpose for quoting exactly from the publication is to make a point early in the thesis: terminology is important if one is to formulate and understand joint doctrine. All operational concepts do not become doctrine. Refering to Figure 2.2, functional concepts are examined through the use of studies and wargames until they are finally published as a TRADOC 525-series pamphlet. **Then and only then** are these concepts incorporated into field manuals which contain doctrine, such as Field Manual (FM) 100-5 which contains the AirLand Battle doctrine [Ref. 16: p.9]. Requirements, based on concepts which continually change, would continually change also--similar to trying to paint a moving train.

To illustrate some more terminology, the operational concept/painting analogy is carried further. A general rule of repainting your house approximately every three years would parallel a *doctrinal* principle. Deciding how to get this done would represent *tactics*. *Techniques* represent the methods of accomplishing the painting, such as using a brush, roller, or spray-paint rig. The *procedures* represent things such as preparation of the house itself for painting and preparation of the paint. [Ref. 18: p.2]

The standardization of terminology is accomplished to some degree by Joint Chiefs of Staff (JCS) Publication 1, Dictionary of Military and Associated Terms. *Doctrine* is defined in JCS Publication 1 as:

> Fundamental principles by which military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgement in application. [Ref. 19: p. 118]

Tactics, derived from the Greek word "taktikos" which means to arrange, is defined in JCS Publication 1 as:

> 1. The employment of units in combat.
>
> 2. The ordered arrangement and maneuver of units in relation to each other and or to the enemy in order to utilize their full potentialities [Ref. 19: p.359].

Sometimes the services define their own terminology. *Techniques* is defined in Army Regulation (AR) 310-25 as:

> Method of performance of any act, especially the detailed methods used by troops or commanders in performing assigned tasks. Technique refers to the basic methods of using equipment and personnel. The phrase 'tactics and technique' is often used to refer to the the general and detailed methods used by commanders and forces in carrying out their assignments. [Ref. 18: p. 8]

Procedures is defined by TRADOC as:

> A particular course or mode of action that describes how to perform a certain task [Ref. 18: p. 9].

Common usage within the services of the terms may not necessarily coincide, even when the term is defined by JCS Publication 1. An unknown author inscribed these words by hand on the flyleaf of an old composition text:

> Words *do* make a difference, whether for good or ill. If our savants took more care choosing their words during the voicing of policy, they could spend more time in cheerful contemplation of the good result they had produced, and less time trying to repair the damage. [Ref. 20: p.25]

Throughout the next chapter on doctrine, key differences in terminology will be highlighted. The differences must be surfaced, resolved, or an agreement to disagree reached if the services are to provide more than lipservice to the word "joint". With the differences between operational concepts and doctrine established, we return to the discussion of Figure 2.2 and the CBRS.

As mentioned earlier, published operational concepts and Army doctrine are studied and analyzed during ***Mission Area Analyses (MAAs).*** Based on the established measures of effectiveness and the results of model runs, the proponent for the study determines the difference between the battlefield requirements and programed capabilities. These differences will be reported as ***deficiencies*** in the ability to execute a given task or an inability to perform the task to required standards. This examination of deficiencies continues until the root cause of each deficiency has been identified. [Ref. 12: p.C-6]

Once deficiencies have been identified, each MAA proponent investigates various means of overcoming them. Deficiencies and solutions are categorized into four areas:

- Doctrine
- Training
- Organization
- Materiel

The procedure for selecting corrective actions start with those actions which are least expensive and most quickly implemented. Corrective actions which are more demanding in time and resources are examined only when the less costly options do not eliminate the deficiency.

Doctrinal solutions can usually be implemented quickly and will not strain resources. It is essential that several new approaches be considered, that they be innovative, and that they do not end up requiring a new organization and new materiel for their implementation. **Training** solutions are not as likely to generate new deficiencies in doctrine, organization, or materiel as can often be the case in reverse. Training solutions do require the services to decide who will be trained and how they will be trained. Depending on how much money is available, this can run the scale from correspondence courses to institutional training at service schools. Introduction of **organizational** changes can sometimes be done quickly, but they frequently have resource and morale implications which must be carefully considered. Institutional forces may oppose the change, forcing any changes to to be implemented in a gradual, evolutionary manner. The most expensive choice, new **materiel,** is a last resort.

Before initiating a new development program to satisfy an Army need or deficiency, four alternatives must be considered:

- Changing tactics, training, doctrine or organizations to satisfy a need.[3]
- Improving an existing Army item to take advantage of existing training and logistics investments.
- Buying existing domestic or foreign commercial or military equipment off the shelf.[4]
- Modifying existing commercial, other service or foreign equipment to meet a system requirement. [Refs. 13,22: pp.10,1.1]

A sound approach to the analysis of tasks will pay dividends in preparing later documents that support the materiel acquisition cycle. If deficiencies are found in these tasks and subtasks that will require development of new equipment or improvement to existing equipment, the proponent will have to prepare a system employment and organization plan (SEOP) and a mission profile/operational mode summary (MP/OMS) for that equipment [Ref. 12: p. C-11].

The system and organization plan (SEOP) is a narrative description of the role and method of employment of an organization or system within the force based on approved operational concepts for combat operations. It should describe what an organization or system is expected to accomplish, how it is expected to perform, and how it interacts with other organizations and systems. The mission profile/operational mode summary (MP/OMS) is a projection of tasks and conditions in terms of frequency and urgency visualized for a system or force employed in military operations. All studies which address organizations or systems will include a SEOP and MP/OMS. [Ref. 23: p. D-1]

These documents assist in preparing the Operational and Organizational Plan (O&O Plan). It is prepared prior to a Justification for Major System New Start (JMSNS) or any other requirements document; it provides a front-end agreement to initiate the materiel acquisition process and is a mandatory element of that process.

Materiel and non-materiel requirements are then incorporated into two other outputs of the CBRS process, **Mission Area Development Plans (MADPs) and the Battlefield Development Plan (BDP).** MADPs translate corrective actions into specific projects with milestone schedules for development. These are prepared by the proponent for each battlefield mission area listed in Figure 2.1. The end product of the whole process for the Army is the BDP. It is the integrating mechanism for the

---

[3]These solutions should have already been considered if the CBRS process has been followed.

[4]Renewed emphasis has been placed on this option by the Chairman of the Senate Armed Service committee, Senator Nunn. [Ref. 21]

deficiencies identified in the four areas of doctrine, training, organization and materiel; the prioritization of projects within MADPs must correspond to the prioritization of deficiencies within the BDP. The BDP is reviewed by the highest levels in the Army to insure that priorities for solving these deficiencies are correctly placed. These priorities provide the focus for developmental efforts and help drive the research and development process. [Ref. 14: p.2-1]

C. OTHER METHODS OF ANALYSIS

A recent paper done by the Chairman of the Joint Command, Control, and Communications (C3) curriculum at the Naval Postgraduate School (NPGS) and a visiting professor from the Naval Research Laboratory (NRL) provides a good review of the services' methods of determining requirements. The paper, titled **Requirements in Department of Defense Acquisition,** proposes a notional acquisition process (Figure[5]2.4). This is compared with the CBRS in Figure 2.5. [Ref. 24: pp.35-37] The **inputs** (current forces, plans, technology, and threat), **outputs** (revised technology and force plans, contract system specifications), and **controls** (guidance, operational concepts) basically agree with the corresponding components of the CBRS.

Similarities also exist in these methods and a methodology developed for evaluating C2 systems and architectures called the Modular Command and Control Evaluation Structure (MCES). Its framework is shown in Figure 2.6 [Refs. 26,27: p. 5, p. 7]. A comparison between it and the CBRS is graphically presented in Figure 2.7. By formulating, bounding, and defining a problem under consideration, the MCES performs similar steps to the CBRS's analysis of mission, threat, historical perspective, and technology forecasts during concept exploration. Integration of these elements and the specification of measures and data generation in MCES correspond to the CBRS's integration of functions through a CAPSTONE concept along with the studies and wargames used to validate the concept. These measures are aggregated and forwarded to a decision maker in the MCES process; MAAs capture the deficiencies and solutions, are forwarded for review by high level decision makers, and are implemented via MADPs and the BDP. The favorable accordance between the two schemes appear to make possible the conclusion that the C2 process and CBRS are compatible.

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[5]The presentation of the process conforms to the elements of the Structured Analysis Design Technique (SADT)^{TM} , a trademark of SofTech, Inc. and developed by Douglas T. Ross [Ref. 25].

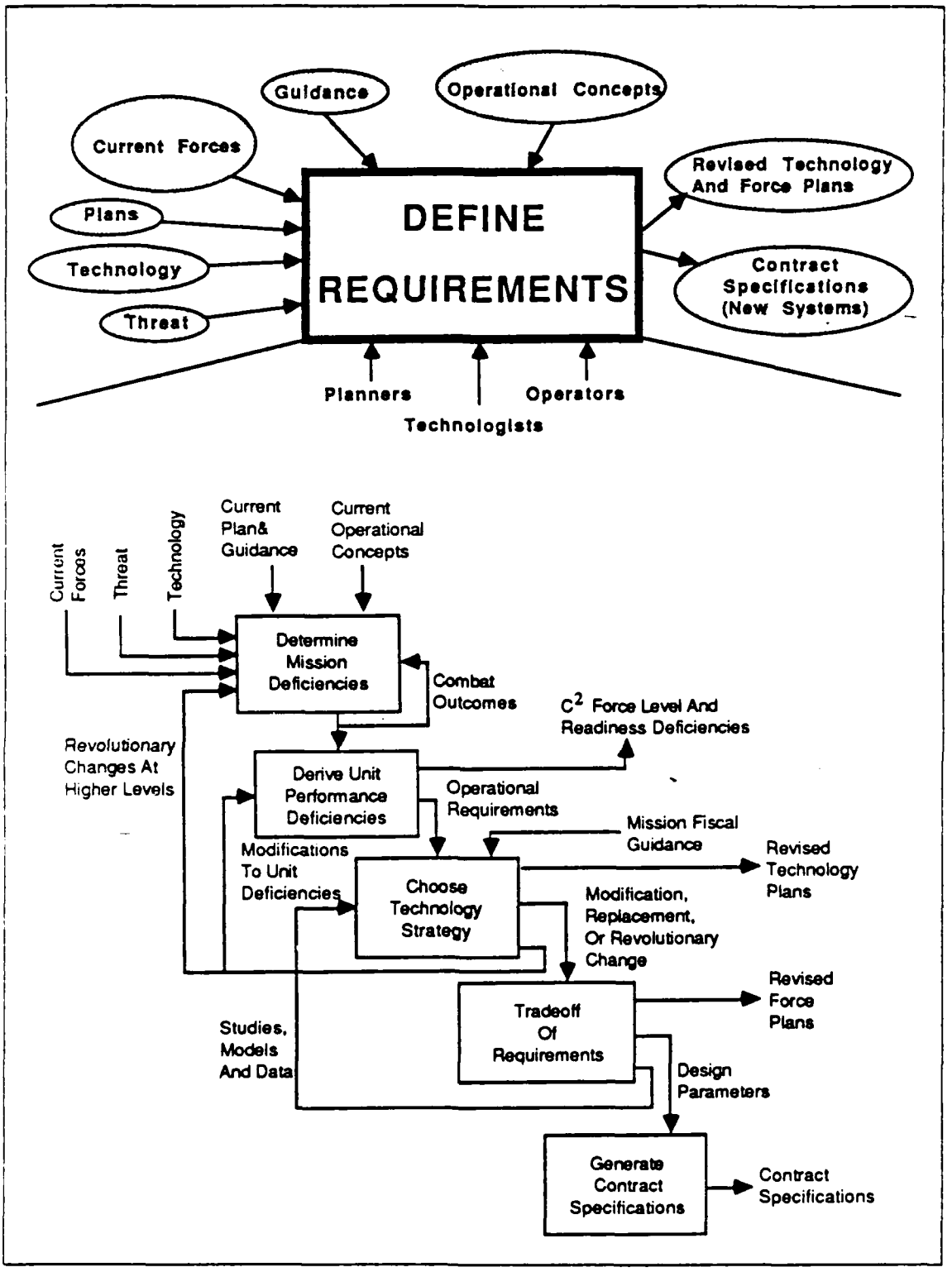

Figure 2.4 Acquisition Requirements Definition Process.

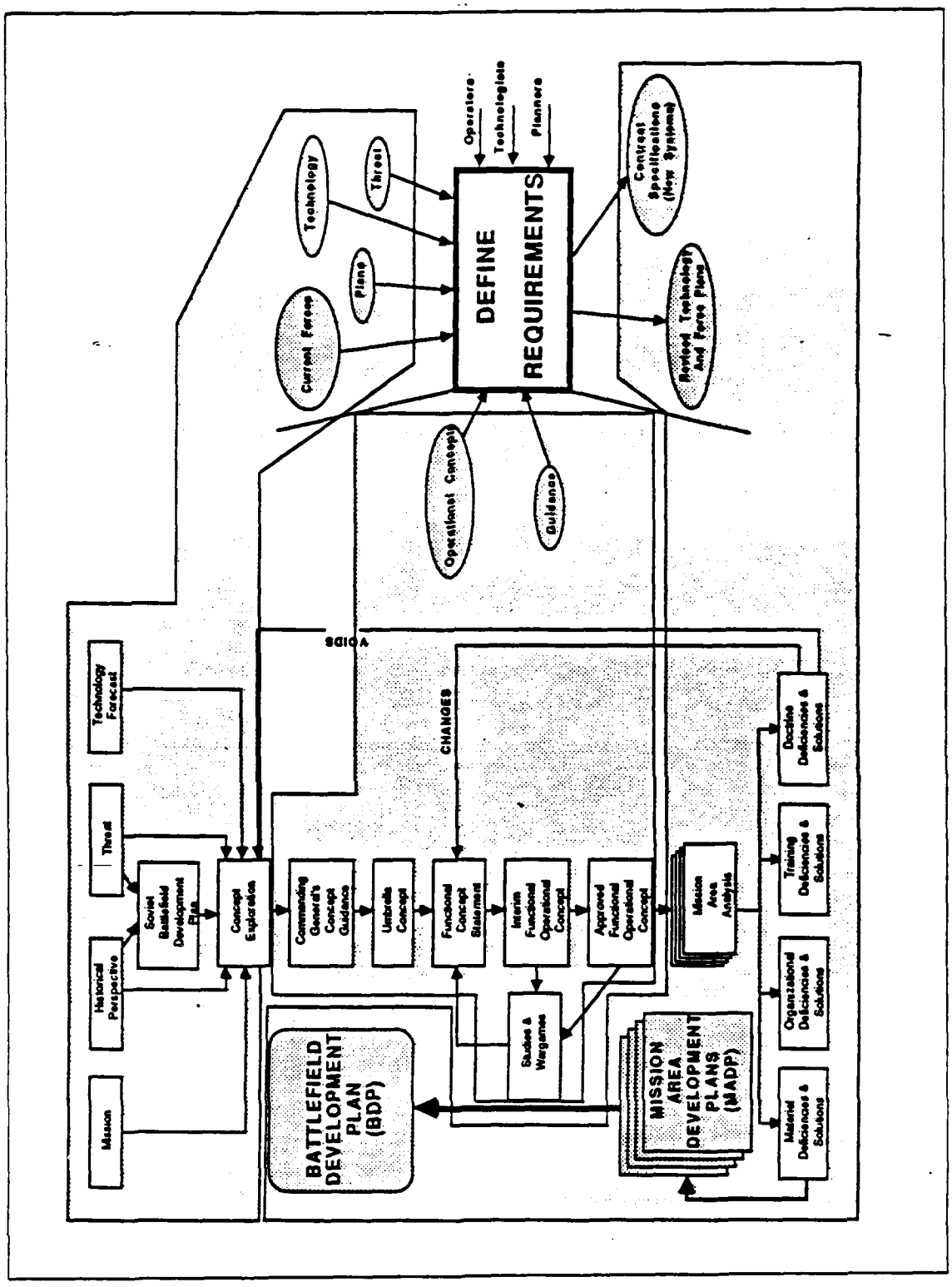

Figure 2.5 Comparison of Requirements Definition Process and CBRS.

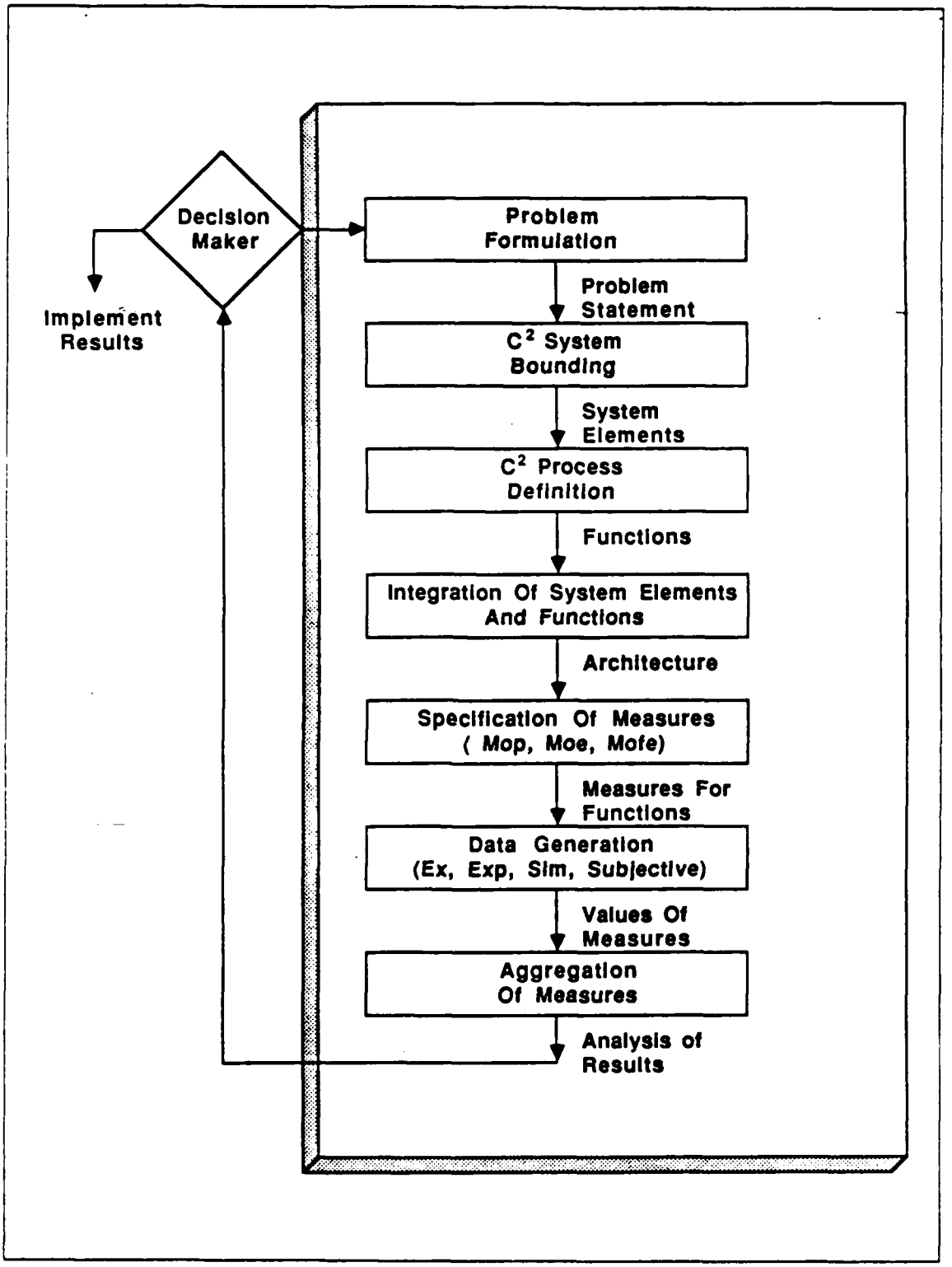

Figure 2.6 Modular Command and Control Evaluation Structure (MCES).

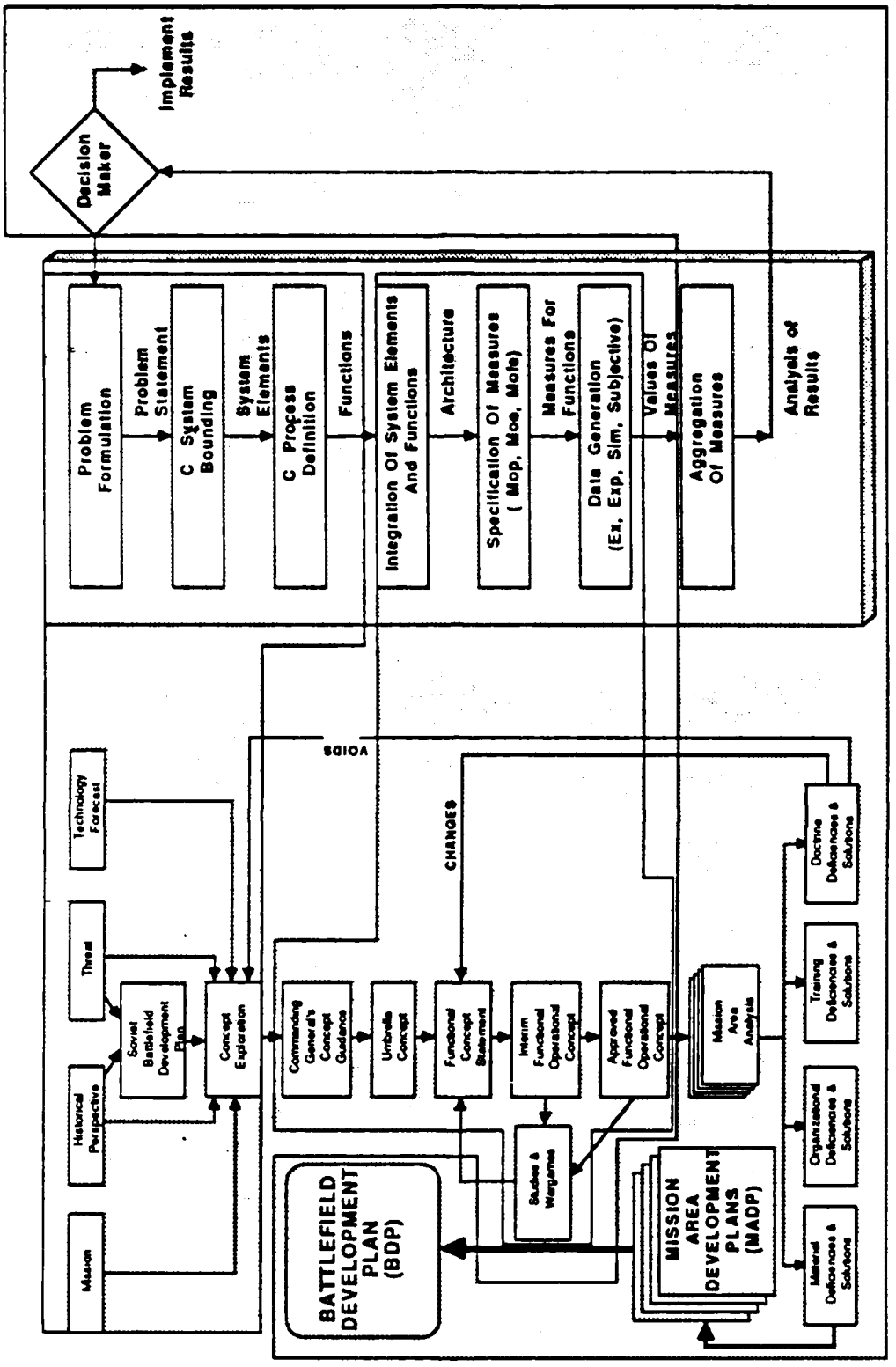

Figure 2.7 Comparison Between MCES and CBRS.

Procedures for examining the link between requirements and operational concepts do exist; several weaknesses in exercising the existing processes for identification of mission deficiencies include:

- Mismatch of grand strategy to resources available.
- Service rather than geographical definition of missions.
- Lack of joint doctrine for employment.
- Disagreement on future threat levels. [Ref. 24: pp.19-20]

Perhaps with the formation of the J7 for Doctrine and J8 for Acquisition, some of these problems can be resolved. The method of correlating doctrine and acquisition will have to start somewhere. If the J7 and J8 are the organizations which must perform the correlation, then the CBRS should be considered as the means of performing the comparison. The existing CBRS has been in use for over a decade, has been recommended for use by other services, and bears enough of a relationship to recent methods of analysis to perhaps be the starting place upon which to build a new system.

D. SUMMARY

This chapter explored the link between doctrine and systems integration of new systems. The Army's Concept Based Requirements System (CBRS) was explained in detail. The importance of understanding the different terminology used by the services was emphasized. A notional acquisition process and the MCES were compared with the CBRS. Since the CBRS has been in use for over a decade, has been recommended for use by other services, and has enough of a relationship to these recently examined methods of analysis, the CBRS was recommended as a starting place for the J7 and J8 relationship.

The next chapter will look at service doctrine. The AirLand Battle and Maritime Strategy will be explained generically. How the Air Force and Army intend to conduct the Joint Attack of the Second Echelon (J-SAK) and how the Navy and Marine Corps intend to conduct Over-the-Horizon (OTH) missions will be explained in detail. Common characteristics of these type missions will lead to joint requirements in the mission area of Long Range Engagements. This will set the stage for exercising the CBRS by considering a space-based laser to designate ground targets for attack.

III. AIRLAND BATTLE AND THE MARITIME STRATEGY: THE FOUNDATION FOR JOINT OPERATIONS

A. GENERAL

Chapter I asserted that a window of opportunity has opened for space support of joint tactical operations. Chapter II examined a method of analyzing military requirements in the context of how the war is envisioned to be fought. This chapter will establish the general and specific context in which space system support will be examined in Chapter IV.

The AirLand Battle is the authoritative foundation on which the Army has based its force design, materiel acquisition, and training products. Until recently, the Air Force had not completely subscribed to all the principles of the concept [Refs. 28,29]. The following portion of an interview published in *Airman Magazine* with the Air Force Chief of Staff, General Larry D. Webb, indicates this may not be the case now.

> Question--Some critics say that joint planning and operations are failures. True of False?
>
> Answer--The facts say false. The record is replete with successes--in areas such as doctrine, training, and operations--that we take for granted. Examples: The Air Force fully supports the Army's Airland Battle Doctrine. In fact, the Air Force helped write the 1986 version of that doctrine. . . . [Ref. 30]

This 1986 version of **Field Manual (FM) 100-5 Operations** contains the AirLand Battle doctrine and provides the general context for the Army and Air Force interplay in performing missions.

The Navy publishes **The Maritime Strategy** which draws together the commonly known but sometimes unwritten[6] concepts of how the Navy envisions its future operations. Because the best developed and most detailed statements of The Maritime Strategy had been available only in classified versions, public debate between its supporters and detractors had often suffered from misinterpretations or exaggerations. In January 1986, a series of unclassified articles by the Secretary of the Navy, Chief of Naval Operations (CNO), and the Commandant of the Marine Corps appeared in a supplement to the U.S. Naval Institute's *Proceedings*. This supplement provided the

[6]Admiral Trost, current Chief of Naval Operations, described the Maritime Strategy over the years as "very much like the British Constitution--unwritten but thoroughly understood by those who must practice it." [Ref. 31: p. 15]

most definitive and authoritative statements of the Maritime Strategy that are available in unclassified form. These articles with updated views from the current CNO provide the general context for Navy and Marine Corps interplay in performing missions. [Ref. 32]

Within these general contexts, common missions obviously exist. AirLand Battle includes deep operations and the Joint Army and Air Force Attack of the Second Echelon (J-SAK) at variable ranges[7] beyond the Forward Line of Troops (FLOT). The Maritime Strategy includes attacking land based targets at Over-the-Horizon (OTH) ranges[8] with STRIKE assets (fighter aircraft, TOMAHAWK cruise missiles). The methods and resources for conducting long range missions are explored in greater detail to highlight the common characteristics. A comparison will be made of the basic principles, methods, and resources used by the services, thus setting the stage for the examination of current and future space systems which may help fill voids in conducting these types of missions.

B. EXPLANATION OF TERMINOLOGY

The Department of Defense (DOD) *Dictionary of Military and Associated Terms, JCS Pub 1*, defines **doctrine** as:

> Fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgement in application. [Ref. 19: p. 118]

Three other types of doctrine are also discussed:

- **Combined Doctrine.** Fundamental principles that guide the employment of forces of ***two or more nations*** in coordinated action toward a common objective. It is ratified by participating nations. [Ref. 19: p. 76]
- **Joint Doctrine.** Fundamental principles that guide the employment of forces of ***two or more services of the same nation*** in coordinated action toward a common objective. It is ratified by ***all four services*** and may be promulgated by the Joint Chiefs of Staff. [Ref. 19: p. 196]
- **Multi-Service Doctrine.** Fundamental principles that guide the employment of forces of ***two or three services of the same nation*** in coordinated action toward a common objective. It is ratified by ***two or three services,*** and is normally promulgated in joint Service publications that identify the participating services, e.g., Army-Navy doctrine. [Ref. 19: p. 237]

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[7] 0 to 100 kilometers ± 50 kilometers.

[8] JCS Pub 1 does not define Over-the-Horizon. The definition for over-the-horizon radar refers to a "range of detection beyond line of sight." [Ref. 19: p. 265]

The services articulate ***fundamental principles*** in different ways. For example, the Army calls its fundamental doctrine ***capstone*** doctrine, while the Air Force makes a distinction between ***basic, operational, and tactical*** doctrine. The basic doctrine of the Air Force is found in *Air Force Manual (AFM) 1-1, Functions and Basic Doctrine of the United States Air Force* and provides an authoritative statement for the employment of Air Force resources. However, unlike the Army, the Air Force has a family of basic doctrines. AFM 1-1 is the umbrella doctrine for the family of basic doctrines which is published in the 1-series manuals. Operational doctrine is published in the 2-series manuals, and each major command publishes mission-oriented doctrine in the major command series. In Air Force writing, ***doctrine*** implies how the service plans to fight in the ***immediate*** future, while ***concept*** implies ***future*** operations. It would seem possible for the Air Force to agree to another service's concept, while disagreeing with their doctrine. Until the firm statement of the Air Force Chief of Staff concerning AirLand Battle, this divergence could have posed serious problems when attempting to write joint Air Force and Army publications. [Refs. 33,34: pp. 29-38, p. 47]

The Navy, unlike the Army and Air Force, does not articulate fundamental doctrine for joint and combined operations in its separate doctrinal naval warfare publications. Instead, the Navy uses the appropriate combined and joint publications as their fundamental doctrine for joint and combined operations. The Navy has no "umbrella" document that integrates the many diverse aspects of naval warfare into a unified and coherent doctrine for the planning and conduct of naval campaigns. The Navy also classifies the bulk of its tactical doctrine. [Refs. 33,35: pp. 33-35, p. 26]

The Marine Corps--like the Navy and unlike the Army and Air Force--does not repeat or amplify fundamental principles for joint and combined operations that are found in JCS publications or combined doctrine publications. However, unlike the Navy, the Marine Corps does publish "white letters" by the Commandant of the Marine Corps which provide guidance for the employment of Marine forces in support of joint and combined operations. [Refs. 33: pp. 35-38]

Since fundamental principles may be expressed as capstone doctrine, basic doctrine, strategy, or white papers, it is **important** to realize **what one is reading,** and more importantly, **what one is searching for,** when interpreting and formulating future concepts in the joint and combined areas. When accepted joint and combined ***doctrine*** exists, it is important to realize that the services ***must*** be employed in line with that doctrine. [Ref. 33: pp.29-30]

It can be argued that AirLand Battle doctrine and the Maritime Strategy are semantically and substantially different. Referring again to JCS Publication 1, **strategy** is defined as:

> The art and science of developing and using political, economic, psychological, and military forces as necessary during peace and war, to afford the maximum support to policies, in order to increase the probabilities and favorable consequences of victory and to lessen the chances of defeat. [Ref. 19: p. 346]

Navy Commander John Bradley concluded in an essay written at the Army War College that the AirLand Battle and Maritime Strategy are compatible on the "operational" level of war. Since most Navy tactical doctrine is classified and in keeping with the unclassified nature of this thesis, the AirLand Battle and the Maritime Strategy are used as the basis for comparison. The principles and **attempt to articulate a foundation** and context for joint operations are the key issues. Until the J7 for Doctrine starts publishing joint doctrine in areas where none currently exists, this discussion represents the author's effort to start the process. The discussion is necessary so that the CBRS method of relating doctrine to military requirements can be examined and used.

The words used in the descriptions which follow are, as much as possible, **the exact words found in the documents referenced.** This is done to permit the reader to interpret what is meant **without** the author's substantial editorial revisions. **Bold-face** and ***italicized*** print have been added to indicate what the author feels are key points. The **Comparison** section of this chapter will highlight the author's opinions of the documents.

C. AIRLAND BATTLE

1. Introduction

The overriding mission of U.S. forces is to deter war. The services support that mission by providing combat units to the unified and specified commands[9] listed in Figure 3.1 [Refs. 36,37,38: pp. 37-38, p. 6, p. 6]. These commands are charged with ***executing the military policies*** of the United States and ***waging war*** should deterrence fail.[10]

All military operations pursue and are governed by political objectives. The translation of success in battle to desired political outcomes is more complicated than ever before. Figure 3.2 [Ref. 39: p.9] illustrates the spectrum of conflict and risk. ***Nuclear war*** represents the ***high risk, low probability*** end of the spectrum. The risk of escalating a lower level conflict to this level imposes unprecedented limitations on operational flexibility. ***Low Intensity Conflict (LIC)*** on the ***other end*** will pit Army forces against irregular or unconventional forces, enemy special operations forces, and terrorists. LIC poses a threat to U.S. interests at all times, not just in periods of active hostilities; fighting in the low end of the conflict spectrum requires special force composition and task organization, rapid deployment, and restraint in the execution of military operation. Between these extremes lies a wide range of possible conflicts which may escalate toward nuclear war and which will almost always involve economic and political actions as well as military activity. [Ref. 16: pp. 1-4]

The Air Force accomplishes its assigned functions through its ***basic operational missions***. These are: strategic aerospace offense, strategic aerospace defense, ***space operations***, surveillance and reconnaissance, airlift, close air support, counterair operations, ***air interdiction, and special operations.*** The Air Force is organized into major commands based upon these missions: strategic offense, strategic defense, strategic and tactical airlift, tactical support of surface forces, and training to support these functions. These major commands are further subdivided into numbered air forces, air divisions, groups, wings, and squadrons.

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[9]A **unified command** is a command with a **broad, continuing mission** under a single commander and composed of significant assigned components of **two or more services.** A **specified command** is a command which has a broad and continuing mission and is normally composed of **one service.** [Ref. 36: p.37]

[10]The Readiness Command has been recommended for elimination to provide resources to activate the Special Operations Command. The Joint Deployment Agency, an activity of the Readiness Command, will be a part of the new Transportation Command. [Refs. 37,38: p. 6, p. 6]

Unified Commands	Specified Commands
Atlantic Command	Strategic Air Command
Central Command	
European Command	
Pacific Command	
Southern Command	
Space Command	
Special Operations Command	
Transportation Command	

Figure 3.1 Unified and Specified Commands.

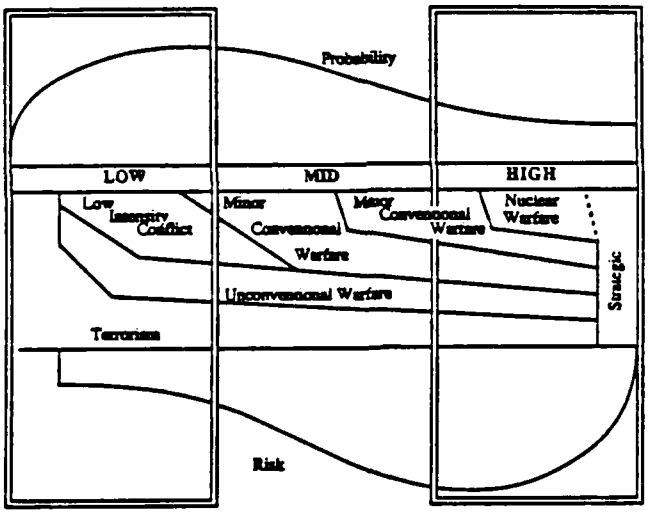

Figure 3.2 Spectrum of Conflict-Army.

The ***mission of the Air Force is the prosecution of the air war.*** To support the AirLand Battle, the Air Force provides the theater commander close air support for land forces, battlefield air interdiction, tactical air reconnaissance and surveillance, air defense, offensive counterair, air interdiction, and special air operations. For effective employment of aerospace forces in a theater of operation, Air Force doctrine states that the ***principles*** of centralized control, decentralized execution, coordinated effort, common doctrine, and cooperation are essential elements and are fundamental to the success of Air Force operations. [Ref. 33: pp. 38-40]

The U.S. Army's basic fighting doctrine is called the AirLand Battle. It reflects the application of the classical principles of war to contemporary battlefield requirements. It is called the AirLand Battle in recognition of the inherently three-dimensional nature of modern warfare and the reliance placed on the U.S. Air Force when conducting operations. All ground actions above the level of the smallest engagements will be strongly affected by the supporting air operations of one or both combatants. AirLand Battle doctrine describes an approach to generating and ***applying combat power*** at the ***operational and tactical levels.*** It **does not** address the formulation of U.S. strategies for deterrence or warfighting. It does provide leaders at all levels with doctrinal guidance for conducting campaigns and major operations and for fighting battles and engagements within the broader framework of military strategy. The three levels of strategic, operational, and tactical operations will be described shortly. The object of all operations, however, is **to impose our will upon the enemy--to achieve our purposes.** The basic elements essential to the understanding of the AirLand Battle are shown in Figure 3.3. [Ref. 16: p. 1, p. 9, p. 14]

- **The Three Levels of War**
- **The Four Tenets of AirLand Battle Doctrine**
- **The Ten AirLand Battle Imperatives**
- **The Three Areas of Operations**

Figure 3.3 AirLand Battle Basics.

2. **The Basics**

a. The Three Levels of War

Military strategy, operational art, and tactics are the broad divisions of activity in preparing for and conducting war.

(1) *Military Strategy.* Military strategy, as defined in JCS Publication 1 and AirLand Battle, is the art and science of employing the armed forces of a nation or alliance to secure policy objectives by the application or threat of force. It establishes goals in theaters of war and theaters of operations. It assigns forces, provides assets, and imposes conditions on the use of force. Strategy ***derived from policy*** must be clearly understood to be the sole authoritative basis of all operations. [Ref. 16: pp. 9-10]

(2) *Operational Art.* **Operational art** is the ***employment of military force to attain strategic goals in a theater of war or theater of operations through the design, organization, and conduct of campaigns and major operations.*** A campaign is a series of joint actions designed to attain a strategic objective in a theater of war. Operational art thus involves fundamental decisions about when and where to fight and whether to accept or decline battle. No particular echelon of command is solely or uniquely concerned with operational art, but theater commanders and their chief subordinates usually plan and direct campaigns, Army groups and armies normally design the major ground operations of a campaign, and corps and divisions normally execute those major ground operations. Operational art requires broad vision, the ability to anticipate, a careful ***understanding of the relationship of means to ends***, and ***effective joint and combined*** cooperation. [Ref. 16: p.10]

(3) *Tactics.* While operational art sets the objectives and pattern of military activities, tactics[11] are the art by which corps and smaller unit commanders translate potential combat power into victorious battles and engagements. Engagements are small conflicts between opposed maneuver forces. Engagements are normally conflicts of a few hours duration fought between divisions and smaller forces. Such engagements may or may not bring on battle. Battles consist of a series of related engagements. Battles last longer, involve larger forces, and often produce decisions that affect the subsequent course of the campaign. Battles occur when large forces--divisions, corps, and armies--commit themselves to fight for significant goals. Sound tactics win battles and engagements by moving forces on the battlefield to gain

[11]JCS Publication 1 definition appears in Chapter II.

positional advantage over the enemy, by applying fire support to facilitate and exploit that advantage, and by assuring the sustainment of friendly forces before, during, and after engagement with the enemy. Sound tactics employ all available combat, combat support, and combat service support where they will make the greatest contribution to victory. [Ref. 16: pp. 10-11]

At both the operational and tactical levels, the generation of combat power requires the ***conversion*** of the potential of forces, resources, and tactical opportunity into actual capability through violent and ***coordinated action*** concentrated at the ***decisive time and place.*** Superior combat power is generated through a commander's combination of the following elements:

- **Maneuver.** The movement of forces in relation to the enemy to secure or retain positional advantage.
- **Firepower.** Provides the destructive force essential to defeating the enemy's ability and will to fight.
- **Protection.** The conservation of the fighting potential of a force so that it can be applied at the decisive time and place.
- **Leadership.** The most essential element of combat power; it provides purpose, direction, and motivation in combat. [Ref. 16: pp. 12-13]

b. The Four Tenets of AirLand Battle Doctrine

Success on the battlefield will depend on the Army's ability to fight in accordance with the four basic tenets of **initiative, agility, depth, and synchronization.**

(1) *Initiative.* ***Initiative*** means setting or changing the terms of battle by action. It implies an offensive spirit in the conduct of all operations. Applied to the force as a whole, initiative requires a constant effort to force the enemy to conform to the operational purpose and tempo of friendly forces. Applied to individual soldiers and leaders, it requires a willingness and ability to act independently within the framework of the higher commander's intent. In the chaos of battle, it is essential to ***decentralize decision authority*** to the lowest practical level because overcentralization slows action. At the same time, decentralization ***risks some loss of precision in execution.*** There are at least two other kinds of risk in combat. One is the risk of losing men and equipment to attain the mission; the other is that a chosen course of action may not be successful, or even if successful, fail to achieve the desired effect. The commander must constantly balance these competing risks, recognizing that ***loss of precision is usually preferable to inaction.*** [Ref. 16: pp. 15-16]

(2) *Agility.* ***Agility,*** the ability of friendly forces ***to act faster than the enemy,*** is the first prerequisite for seizing and holding the initiative. Such greater quickness permits the rapid concentration of friendly strength against enemy vulnerabilities. This must be done repeatedly so that by the time the enemy reacts to one action, another has already taken place. This leads to disrupted plans and late, uncoordinated, and piecemeal enemy responses. This has sometimes been referred to as "acting within the enemy's decision cycle".[12]

(3) *Depth.* ***Depth*** is the ***extension of operations in space,***[13] ***time, and resources.*** Through the use of depth, a commander obtains the necessary space to maneuver effectively, the necessary time to plan, arrange, and execute operations and the necessary resources to win. In pursuit of operational objectives, large unit commanders observe enemy movements in depth and protect their own vulnerabilities throughout the theater. ***In conjunction with air and naval operations,*** they employ maneuver, fires, and special operations to attack enemy units, facilities, and communications throughout the theater and to force the enemy to fight battles on their terms. Exploitation of depth in operations requires commanders to see beyond the requirements of the moment, actively seek information on the area and the enemy in depth, and employ every asset available to extend operations in ***time and space.*** [Ref. 16: pp. 16-17]

(4) *Synchronization.* ***Synchronization*** is the ***arrangement of battlefield activities in time, space, and purpose to produce maximum relative combat power at the decisive point.*** Synchronization is both a process and a result. Commanders synchronize activities; they thereby produce synchronized operations. Synchronization includes but is not limited to the actual concentration of forces and fires at the point of decision. Some of the activities which must be synchronized in an operation--interdiction with maneuver, for example--must occur before the decisive moment and may take place at locations far distant from each other. While themselves separated in time and space, however, these activities are ***synchronized if their combined consequences are felt at the decisive time and place.*** Synchronization **need not depend on explicit coordination** if all forces understand the intent of the commander, and if they have developed and rehearsed well-conceived standard responses to anticipated contingencies. In the chaos of battle, when communications fail and face-to-face

[12]A good discussion on "The Role of Time in a Command Control System" appears in a paper written by Dr. Joel Lawson [Ref. 40].

[13]"Space" in this context does not mean outer space.

coordination is impossible, such implicit coordination may make the difference between victory and defeat. ***The less that synchronization depends on active communication, the less vulnerable it will be.*** [Ref. 16: pp. 17-18]

c. The Ten Imperatives of the AirLand Battle

The fundamental tenets of AirLand Battle doctrine describe the characteristics of successful operations. While initiative, agility, depth, and synchronization characterize successful AirLand Battle operations, the imperatives listed below prescribe key operating requirements. These provide more specific guidanee than the principles of war and the AirLand Battle tenets; they apply to all operations and are historically valid. The ten imperatives of AirLand Battle are:

(1) *Ensure Unity of Effort.* The fundamental prerequisite for unity of effort within organizations is an ***effective system of command*** which relies upon leadership to provide purpose, direction, and motivation. This system emphasizes well-understood common doctrine, tactics, and techniques as well as sound unit standing operating procedures (SOPs) and takes effective measures to limit the effects of friction.[14] [Ref. 16: p. 23]

(2) *Anticipate Events on the Battlefield.* Predictions about the enemy and even our own troops can never be relied on with certainty, but it is nevertheless essential to anticipate what is possible and likely and prepare for those possibilities. Anticipating events and foreseeing the shape of possibilities hours, days, or weeks in the future are two of the most difficult skills to develop, yet among the most important. Anticipation and foresight are ***critical to turning inside the enemy's decision cycle and maintaining the initiative.*** [Ref. 16: p. 23]

(3) *Concentrate Combat Power Against Enemy Vulnerabilities.* To know what his vulnerabilities are, commanders must study the enemy, know and take into account his strengths, find his inherent vulnerabilities, and know how to create new vulnerabilities which can be exploited to decisive effect. Combat power must be ***concentrated to reach points of enemy vulnerability quickly without loss of synchronization.*** [Ref. 16: pp. 23-24]

(4) *Designate, Sustain, and Shift the Main Effort.* The main effort is assigned to the element with the most important task to accomplish within the commander's concept. The commander concentrates his support to ensure quick success by this element. ***The main effort assures synchronization in the operation while***

[14]A term used by Clausewitz to describe the confusion and unpredictability of war.

leaving the greatest possible scope for initiative. If conditions change and success of the overall mission can be obtained more cheaply or quickly another way, the commander shifts his main effort to another force. [Ref. 16: p. 24]

(5) *Press the Fight.* Campaigns or battles are ***won by the force that is most successful in pressing its main effort to a conclusion.*** Commanders must accept risks and tenaciously press soldiers and systems to the limits of endurance for as long as necessary. [Ref. 16: p. 24]

(6) *Move Fast, Strike Hard, and Finish Rapidly.* Speed has always been important to combat operations, but it will be even more important on the next battlefield. Engagements must be violent to shock, paralyze, and overwhelm the enemy force quickly. They must be ***terminated rapidly*** to allow the force to disperse and avoid effective enemy counterstrikes. [Ref. 16: p. 24]

(7) *Use Terrain, Weather, Deception, and OPSEC.* ***Terrain and weather affect combat more significantly than any other physical factors.*** The ground and the airspace immediately above it have an immense influence on how the battle will be fought. They provide opportunities and impose limitations. Similarly, effective deception and tight operations security (OPSEC) can enhance combat power by confusing the enemy and reducing his foreknowledge of friendly actions. [Ref. 16: p. 24]

(8) *Conserve Strength for Decisive Action.* Successful commanders conserve the strength of their forces to be stronger at the decisive time and place. Commanders must ***minimize the diversion of resources to nonessential tasks*** and retain a reserve for commitment when needed most. [Ref. 16: pp. 24-25]

(9) *Combine Arms and Sister Services to Complement and Reinforce.* The ***greatest combat power results when weapons and other hardware, combat and supporting arms, Army units, and other service elements of different capabilities are employed together to complement and reinforce each other.*** Arms and services *complement* each other by posing a dilemma for the enemy. As he evades the effects of one weapon, arm, or service, he exposes himself to attack by another. Arms and services *reinforce* each other when one increases the effectiveness of another or several combine to achieve mass. [Ref. 16: p. 25]

(10) *Understand the Effects of Battle on Soldiers, Units, and Leaders.* Commanders and their staffs must understand the effects of battle on soldiers, unit, and leaders because war is fundamentally a contest of wills, fought by men not

machines. Commanders must understand that ***in battle, men and units are more likely to fail catastrophically than gradually.*** Commanders and staffs must be alert to small indicators of fatigue, fear, indiscipline, and reduced morale, and take measures to deal with these *before* their cumulative effects drive a unit to the threshold of collapse. [Ref. 16: pp. 25-26]

d. The Three Areas of Operations

Close, rear, and deep operations comprise a special and continuous synchronization requirement. For commanders at ***division and above,*** synchronization of close, rear, and deep operations will normally require deliberate planning and staff coordination since such operations will frequently employ ***different assets.*** At ***brigade and below,*** these activities are practically indistinguishable and will ***usually be conducted with the same assets.*** At every level, however, commanders must understand the relationship among these three arenas and their combined impact on the course of battle.

(1) *Close Operations.* Close operations at any echelon comprise the ***current activities of major committed combat elements, together with their immediate combat support and combat service support.*** At the operational level, close operations comprise the efforts of large tactical formations--corps and divisions--to win current battles. At the tactical level, close operations comprise the efforts of smaller tactical units to win current battles or engagements. At any echelon, close operations include the close, deep, and rear operations of subordinate elements. Not all activities taking place in proximity to the line of contact are close operations. Activities are part of close operations if they are designed to support the current fight. Close operations bear the ultimate burden of victory or defeat. The measure of success of deep and rear operations is their eventual impact on close operations. [Ref. 16: p. 19]

(2) *Rear Operations.* Rear operations at any echelon comprise ***activities rearward of elements in contact designed to assure freedom of maneuver and continuity of operations, including continuity of sustainment and command and control.*** Four rearward activities in particular must be conducted as part of rear operations:

- Assembly and ***Movement of Reserves.***
- Redeployment of Fire Support.
- ***Maintenance and Protection of the Sustainment Effort.***
- Maintenance of Command and Control.

In addition to these critical activities, others relevant to rear operations include establishment and maintenance of lines of communications (LOCs), traffic regulation and control, medical and field services, refugee control and maintenance of civil order. By themselves, none of these activities would normally have much impact on the current battle. However, because it is precisely these activities which will be the targets of the enemy's deep operations, their protection can easily begin to divert needed assets from the forward battle. [Ref. 16: pp. 20-21]

(3) *Deep Operations.* Deep operations at any echelon comprise ***activities directed against enemy forces not in contact designed to influence the conditions in which future close operations will be conducted.*** At the operational level, deep operations include efforts to isolate current battles and ***to influence where, when, and against whom future battles*** will be fought. At the tactical level, deep operations are designed to shape the battlefield to assure advantage in subsequent engagements. At both levels, successful deep operations create the conditions for future victory. Such operations are ***not new*** to warfare. The concept of interdicting the enemy's supplies, follow-on forces, reserves, and communications to impede his ability to commit these at times and places of his choosing is a familiar feature of modern war. The ***principal difference*** in such operations ***today*** is the ***increasing availability of means to conduct them at the tactical as well as the operational level.*** Deep operations must be synchronized with the scheme of maneuver. Deep operations support tactical offensive operations by isolating the battlefield from reinforcing or counterattacking reserves, disrupting the enemy's combined arms cooperation and operational command and control, and destroying or degrading his sustaining support. Deep operations support defensive operations by creating windows of opportunity for decisive action against leading enemy echelons. Areas of operations and interest[15] must extend far enough forward of the FLOT to give the commander time to react to approaching enemy forces, to assess his operations, and to execute operations accordingly. Even in conventional combat, these operations will rarely maintain a linear character. The speed with which today's forces

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[15]Tactical commanders fight the enemy in an **area of operations,** ***a specific zone or sector assigned to them.*** They must also identify and monitor enemy activity ***outside their areas of operations which could affect their future operations.*** This larger area varies in size and shape and is called an **area of interest.** Author's note: **Area of influence** is contained in documents published earlier than 1986 and in JCS Pub 1. It is defined as the assigned area of operations wherein a land commander is capable of acquiring and fighting enemy units with assets organic to or in support of his command or area of operations.

can concentrate and the high volumes of supporting fires they can bring to bear will make the intermingling of opposing forces nearly inevitable. Similarly, from the first hours of battle, deep reconnaissance, air mobility, long-range fires, and special operating forces will ***blur the distinction between front and rear.*** [Ref. 16: p. 2, p. 19]

3. **The Methods and Resources of Conducting Deep Operations**

a. Methods

(1) *Activities.* Among the activities typically conducted as part of deep operations are:

- Deception.
- **Deep surveillance and target acquisition.**
- **Interdiction (by ground or air fires, ground or aerial maneuver, special operating forces (SOF), or any combination of these).**
- Command, control, and communications countermeasures.
- Command and control.

Because of the relative scarcity of resources with which to perform these activities, deep operations ***must be focused*** against those enemy capabilities which most directly threaten the success of projected friendly operations. At the operational and tactical levels, the ***principal targets of deep operations are the freedom of action of the opposing commander and coherence and tempo of his operations.*** Enemy reserves, fire support elements, command and control facilities, and other high value assets beyond the line of contact are potential targets for attack. Target development is an intelligence activity that supports the commander's efforts to identify, locate, and strike high value targets as part of his deep operations plan. In order to assess target value, candidate targets must be evaluated using tactically meaningful criteria. High value targets are those which are:

- ***Relevant*** to the overall operation planned or in progress in that they can affect the force's ability to accomplish the mission.
- ***Most threatening*** to accomplishment of the mission. Since not all relevant targets can be dealt with, they must be prioritized.
- ***Most damaging*** to the coherence of enemy operations. Among relevant and threatening targets, these are the targets of choice.

Intelligence officers develop basic target information, then employ intelligence, surveillance, and target-acquisition assets to ***locate targets accurately enough for attack.*** Following such attacks, intelligence officers assess their efforts and monitor the target to assure that the commander's intention has been accomplished. Only in rare cases

will commanders be able to destroy enemy forces in depth. However, they will often be able to delay, disrupt, or divert selected enemy forces by destroying portions of those forces, by interrupting their support, or by creating obstacles in depth.

(2) *Joint Attack of the Second Echelon (J-SAK).* The operational concept and procedures for attacking deep targets are contained in two joint U.S. Readiness Command (USREDCOM), Training and Doctrine Command (TRADOC), and Tactical Air Command (TAC) pamphlets. They are:

- Joint Operational Concept for J-SAK--USREDCOM Pam 525-4, TRADOC Pam 525-16,[16] TACP 50-26.
- General Operating Procedures for J-SAK--USREDCOM Pam 525-8, TRADOC Pam 525-45, TACP 50-29.

The command and control organization for attacking second echelon[17] targets with air and land forces is shown in Figure 3.4 [Ref. 42: p. 2-3]. The concept and procedures describe the targeting process and also acknowledge that interdiction operations can be conducted by sea forces. [Refs. 41,42: pp. 1-1 thru 1-3, p. 1-1]

The **Joint Force Commander (JFC)** has operational command[18] of all assigned forces. The JFC's concept of operations lists the guidance and objectives for attack of the second echelon. Operational command is exercised through the subordinate component commanders. Special operations forces, which are normally controlled at the joint force level, may enhance second echelon attack through target acquisition, target attack, human intelligence, and personnel recovery operations [Ref. 43]. ***Air apportionment*** is the ***responsibility of the JFC.*** **Air apportionment** ***is the determination and assignment of the total expected tactical air (TACAIR) effort, by percentage or priority, that should be devoted to the various tactical air operations or geographical areas for a given time.*** The air apportionment process prioritizes the TACAIR effort among the following missions:

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[16]Recall from Chapter II that a 525-series pamphlet constitutes a directive to include the concept in training and doctrinal publications.

[17]The second echelon is defined as enemy ground military formations not directly engaged in the battle at the FLOT and held behind the forces in contact as a reserve force, a Soviet-style second echelon, operational maneuver group, or follow-on force.

[18]Operational command **does not include such matters as administration, discipline, internal organization, and unit training,** except when a subordinate commander requests assistance. The term is **synonymous with "operational control"** and is uniquely applied to **the operational control exercised by the commanders of unified and specified commands over assigned forces** in accordance with the National Security Act of 1947, as amended and revised. [Ref. 19: pp. 258-259]

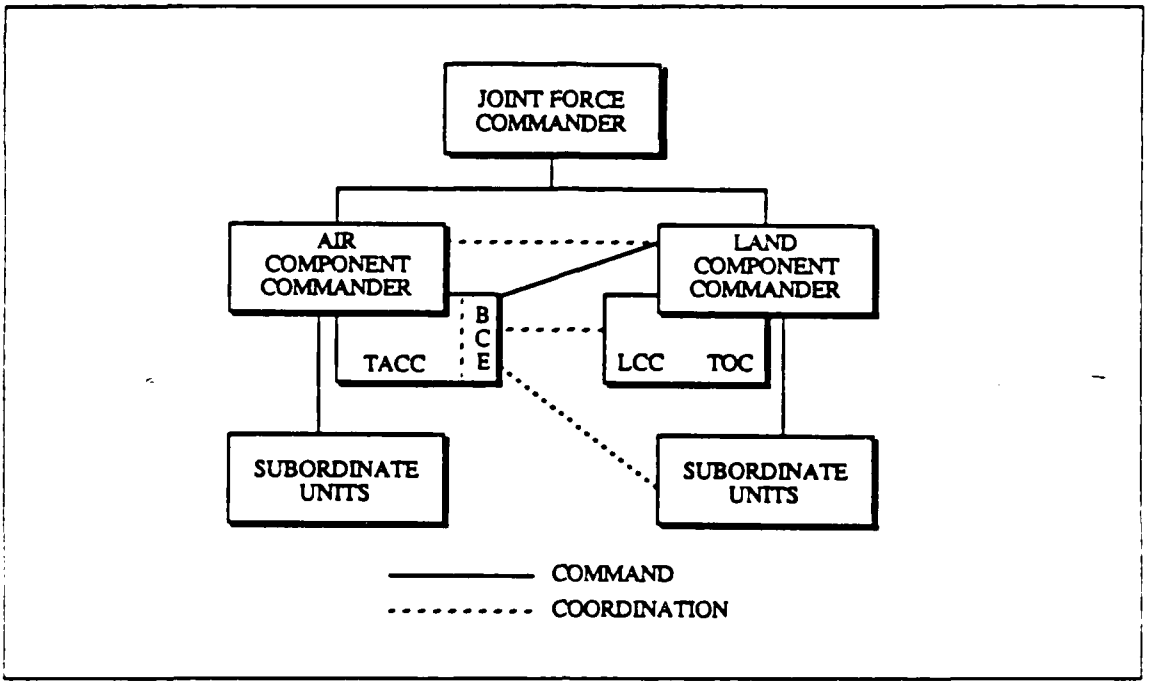

Figure 3.4 Command and Control for J-SAK.

- Air Interdiction (AI)
- Counter Air (CA)
- Close Air Support (CAS)
- Tactical Surveillance and Reconnaissance
- Tactical Airlift
- Special Operations

The air interdiction apportionment establishes the percentage or priority of effort for AI and battlefield air interdiction[19](BAI). ***Apportionment will be accomplished by the Air Component Commander (ACC) and submitted to the joint force commander for approval.***

The **ACC** is responsible for insuring close combat and general support are provided to land forces. Close combat support is provided by CAS missions flown to attack targets in close proximity to friendly land forces. General support is provided by ***interdicting the enemy's combat power before it can be brought to***

[19]**Air interdiction (AI)** operations delay, disrupt, divert, or destroy an enemy's military potential before it can be brought to bear effectively against friendly forces. **Battlefield Air Interdiction (BAI)** operations are air interdiction attacks against targets which have a ***near term effect*** on the operations or scheme of maneuver of friendly forces, but are not in close proximity to friendly forces. [Ref. 16: pp. 48-49]

bear on friendly forces and by attaining and maintaining air superiority. General support attack missions are provided by the TACAIR missions of air interdiction and counter air. The **Tactical Air Control Center (TACC)** is the operational facility in which the ACC and elements of his tactical headquarters operations and intelligence staff have centralized the functions of planning, directing, and control over TACAIR resources. [Ref. 42: p. 3-2]

The **Land Component Commander (LCC)** is responsible for **nominating** BAI targets of interest for all land echelons through the **Battlefield Coordination Element (BCE)** to the ACC prior to the allocation of TACAIR resources. The ***BCE represents the LCC*** and is colocated with the TACC. The TACC determines which targets can be attacked with the available air resources and may recommend alternative targets based upon intelligence, environmental factors, and aircraft capabilities. The LCC makes his priorities and guidance sufficiently clear so that his BCE chief[20] is able to prioritize the competing land force needs of subordinate units for tactical support. In an emergency, with no communications with the LCC, the BCE is delegated the authority by the LCC to adjudicate competing land force needs for tactical support. Similarly, the ACC has the full authority to order an airborne diversion in those instances when the situation dictates it (change of target, mission, or destination). [Ref. 42: p. 2-12, pp. 3-2 thru 3-12]

The means for implementing tactical air support is the **Air Tasking Order (ATO).** The ATO tasks units to accomplish specific missions and provides sufficient detail to enable mission aircrews to execute these missions. Before 48 hours until mission execution, the LCC must prioritize his BAI requests and consult with the ACC on the apportionment decision. At 36 hours out, the ACC submits the air apportionment recommendation at which time it is approved or modified. From 36 hours until the time to launch, the assignment of attack assets to targets through the targeting process is accomplished. The ATO is published at 12 hours before mission execution. [Ref. 42: pp. 5-1 thru 5-13]

Corps orient on the ***operational level of war.*** The corps ***area of interest is 96 hours forward of the FLOT.*** National, Air Force and Army intelligence systems identify, locate, and track enemy forces; this information is relayed to the All Source Intelligence Center (ASIC). **Corps second echelon targets are attacked primarily by TACAIR.** [Refs. 16,42: pp. 46-47, pp. 4-1 and 4-2]

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[20]This position is authorized an Army Colonel (O6) in the Table of Organization and Equipment (TOE) [Ref. 42: p. 3-4].

(3) *Targeting Process.* Targeting is the process through which targets are selected for attack, desired results are determined, and weapons are selected. Desired results are based on a stated mission, force posture and capability, doctrine, plans and intelligence.

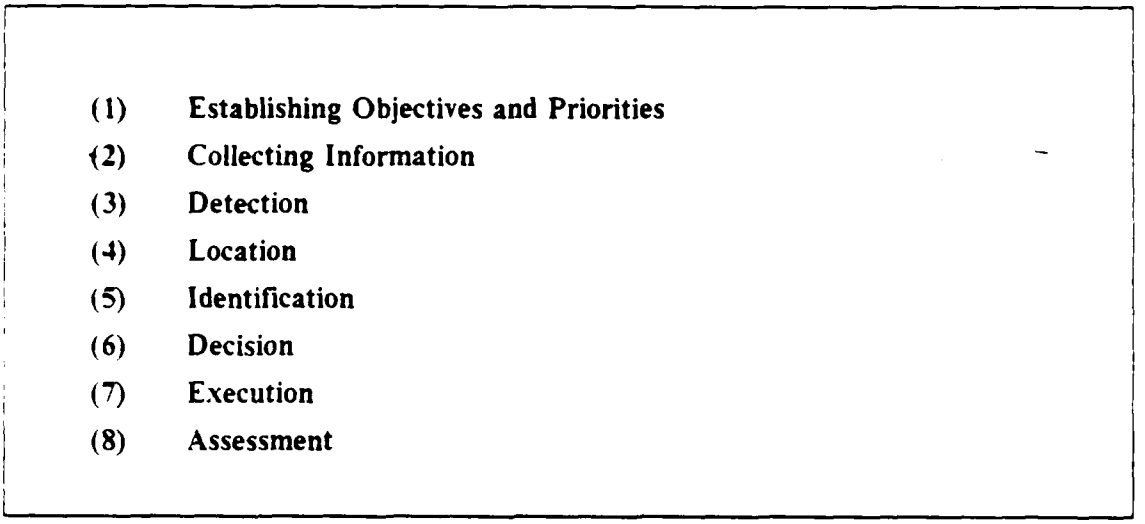

Figure 3.5 Targeting Process for J-SAK.

The process is shown in Figure 3.5 and is described below:

(1) **Establishing Objectives and Priorities.** Attack of the second echelon will be guided by the joint force commander's objectives and priorities. Once the joint force commander has issued guidance concerning objectives, subordinate commanders begin the targeting process by issuing specific guidance in support of their concept of operations.

(2) **Collecting Information.** Effective targeting decisions depend on a responsive intelligence collection program and construction and maintenance of a reliable data base. The first step in collecting information is Intelligence Preparation of the Battlefield (IPB). This begins as soon as the area of operations is identified and requires continuous updating.

(3) **Detection.** Detection of targets involves the discovery of a new potential target or a significant change to an existing one. Terrain and traffic pattern analysis, combined with sensor and intelligence reports, and enemy order of battle, must be used in the detection of targets of military value.

(4) **Location.** Newly detected targets must be located accurately within designated reference systems. Fixed targets (Bridges, road junctions, mine emplacement, hardened C3I sites) are designated by grid coordinates. Targets which exhibit limited dwell time or cannot be accurately fixed by grid coordinates (Mobile command posts, transportable bridging equipment) are designated by four sets

of grid coordinates which outline the probable target engagement zone. [Ref. 42: p. 5-5]

(5) **Identification.** Each target will be analyzed and evaluated, based on the following criteria:

- The desired effect and relationship to the land commander's plan of maneuver.
- The contribution the target makes to the execution and cohesion of the defense or momentum of attacking units.
- The time or location on the battlefield where the target makes its greatest contribution to the cohesion or integrity of the second echelon force as it moves to battle.
- The effect at the FLOT as a result of disruption, delay, and destruction of targets at their present location on the battlefield.

(6) **Decision.** Once detected, located, and identified, targets are further analyzed to determine their significance in light of available weapon systems resources. This includes determining the vulnerability of the target to terrain denial operations, the vulnerability of the target to friendly weapon systems at its present location and as it moves toward the FLOT, and the threat that the target and target environment pose to air and land operations. At this point, a commitment to a course of action is made. Air Force tactical air control party personnel will advise corps and divisions on the capabilities and limitations of tactical air forces to attack potential targets. Land commanders must decide whether to attack targets with organic or supporting land assets or identify targets to the next higher level of command.

(7) **Execution.** In this phase, the planned action is carried out either by the ground commander with organic or supporting land attack assets or by Air Force assets under the control of the TACC acting for the air component commander.

(8) **Assessment.** Assessment identifies the impact of attacking enemy forces, facilities, capabilities and activities. A responsive system of post attack analysis to include inflight reports, evaluation and feedback is required. The headquarters responsible for initial target nomination is also primarily responsible for initiating post attack analysis and must actively seek post attack information to evaluate the target and determine if further attacks are required.

b. Resources

The primary resources for performing deep operations are:

- Tactical air (TACAIR) support.
- Long-range artillery.
- Attack helicopter units.
- Electronic warfare systems.
- Special operating forces.
- Air assault and airborne units.

Divisional brigades and smaller tactical units do not normally conduct separate deep operations. Corps and larger units have access to service and national intelligence collection means which directly support the planning and conduct of deep operations. Divisions, separate brigades, and regiments must depend more heavily on intelligence obtained by higher levels of command for their operations in depth. A thorough Intelligence Preparation of the Battlefield (IPB) and timely intelligence from organic and supporting sources help to identify targets. Named areas of interest (NAI), covering routes or avenues of approach, directions of enemy movement, and specific enemy units are the critical points in an area of interest. They focus the intelligence collection effort and the unit fires during the battle. Close coordination between levels of command is necessary to assure that deep operations plans support the overall concept of operations and neither duplicate nor impede each other.

The **primary strike assets** ***for deep attack are aerial, artillery, and missile weapons.*** Some of the platforms and munitions used to accomplish these deep strike missions are shown in Figure 3.6. Laser systems and munitions are emphasized here and will be also be emphasized in the Maritime Strategy discussion which follows. The reason for this will be discussed in the Comparison section of this chapter. [Ref. 44]

Special Operations Forces (SOF) conduct operations deep in the enemy's rear and usually concentrate on strategic and operational goals. These goals include interdicting enemy lines of communications and destroying military and industrial facilities. Special forces elements can deploy unilaterally into the enemy's rear area to assist in the attack of uncommitted enemy forces by locating, identifying, and destroying targets of operational value.

System	Service	Employment Platform	Range
Laser Spot Tracker/Acquisition Systems			
Target Acquisition System and Designation Sight (TADS)	Army	AH-64A helicopter	10 kilometers
PAVE PENNY Pod contained laser seeker and tracker	Air Force	A-7,A-10	20 + miles
Target Designation Systems			
Ground Vehicle Laser Locator Designator (G VLLD)	Army	Ground (Tripod or vehicle mount)	3 - 5 kilometers
Laser Target Designator(LTD)	Army	Ground (handheld)	1kilometer (Point) 3kilometers (Area)
PAVE SPIKE Pod contained, electro-optical laser designator/ranging system	Air Force	F-4D,F-4E	Slant Range/Visib. Dependant
PAVE TACK Pod contained, electro-optical, laser system used with conventional and laser guided weapons	Air Force	F-4E,RF-4C F-111F	Slant Range/Visib. Dependant
Low Altitude Navigation and Targeting Infrared for Night (LANTIRN)	Air Force	A-10,F-15E, F-16	Variable
Mast Mounted Sight (MMS)	Army	OH-58D helicopter	10 kilometers
AQUILA	Army	Remotely Piloted Vehicle (RPV)	Classified
Laser Guided Munitions			
HELLFIRE	Army	AH-64A,UH-60 helicopters	5 kilometers
COPPERHEAD	Army	155mm Howitzer	3 - 16 kilometers
PAVEWAY I,II, Laser Guided Bombs (LGB)	Air Force	Any attack	Up to
PAVEWAY III Low Level Laser Guided Bombs (LLLGB)		or fighter aircraft	6 kilometers

Figure 3.6 Army and Air Force Platforms and Munitions.

Special forces detachments may have the following missions:

- Intelligence collection.
- Target acquisition.
- **Terminal guidance for strike aircraft and missile systems.**
- Interdiction of critical transportation targets.
- Destruction of nuclear storage sites and command and control facilities.
- Personnel recovery.

D. MARITIME STRATEGY

1. Introduction

In the early 1980s, the public Maritime Strategy discussion had largely taken the form of a debate on the pages of American public and foreign affairs and national security periodicals. This debate focused on two themes: The general forward strategic principles (and certain highly publicized Norwegian Sea examples) enunciated repeatedly by then-Secretary of the Navy John F. Lehman, Jr. and an alleged "Maritime Strategy versus Coalition Warfare" dichotomy propounded by former Under Secretary of Defense Robert Komer and others. [Ref. 45: p. 113]

At the same time, the staffs of the Chief of Naval Operations and the Commandant of the Marine Corps--in conjunction with officers of the other services and allies--had been tasked to develop for internal use a detailed description of the Maritime Strategy component of U.S. national military strategy. This Maritime Strategy integrated into one clear, consistent document the following:

- A number of long held views of Navy and Marine Corps senior officers.[21]
- Certain newly refined concepts developed in the fleet and at the Naval War College.
- Agreed national intelligence estimates.
- The strategic principles articulated by Secretary Lehman.

Concepts developed by the Navy's warfare communities and fleets, as well as by Army, Air Force, joint, and allied commanders, were examined and incorporated as appropriate. The job was spearheaded by the Strategic Concepts Group on the staff of the Chief of Naval Operations. [Ref. 45: p. 113]

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[21]The current CNO states: "The Maritime Strategy represents a consensus of professional opinion and carries the acceptance of both the U.S. Government and the governments of our allies" [Ref. 31: p. 15].

In 1984, the Maritime Strategy was approved by Admiral James D. Watkins, then-Chief of Naval Operations, and General P.X. Kelley, Commandant of the Marine Corps. In late 1985, Secretary Lehman, Admiral Watkins, and General Kelley--having ensured that the Maritime Strategy met their requirements and represented both their thinking and that of their superiors--submitted manuscripts containing the strategy's basic tenets to the Naval Institute; these articles were published in a special supplement to the January 1986 *Proceedings*. [Ref. 45: p. 113]

The Maritime Strategy, set in the context of national strategy, emphasizes coalition warfare, the criticality of allies, and the cooperation of the other services. It supports the pillars of the national strategy:

- Deterrence
- Forward Defense
- Alliance Solidarity

It recognizes that the ***unified and specified commanders*** listed in Figure 3.1 ***fight the wars.*** It **does not** purport to be a detailed war plan with firm timelines, tactical doctrine, or specific target sets. It is ***designed to support campaigns in ground theaters of operations*** both directly and indirectly and thus ***places great emphasis on joint operations.*** [Ref. 46]

The **goal** of the overall Maritime Strategy is to use maritime power, in combination with the efforts of the other services and forces of the allies, to **bring about war termination on favorable terms.** In a global war, the objectives are to:

- **Deny** the Soviets their kind of war by exerting global pressure, indicating that the conflict will be neither short nor localized.
- **Destroy** the Soviet Navy: both important in itself and a necessary step to realize other objectives.
- **Influence** the ***land battle*** by limiting re-deployment of forces, by ensuring reinforcement and resupply, and by ***direct application of carrier air*** and amphibious power.
- **Terminate** the war on terms acceptable to the United States and the allies through measures such as threatening direct attack against the enemy's homeland or changing the nuclear correlation of forces.

The Strategy is a design for ***relating means to ends.*** The ends are clear: deterrence or--should deterrence fail--war termination on terms favorable to the United States and its allies. The means are also clear: the 600-ship Navy.[22] The basic concepts essential to the understanding of the Maritime Strategy are shown in Figure 3.7. [Ref. 46]

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[22]Admiral Trost has written: (The Maritime Strategy) "was not--and is not--a force-builder, and it was certainly not the origin of the 600-ship Navy" [Ref. 31: p. 15].

- Peacetime Presence
- Crisis Response
- Warfighting
  - (1) Deterrence or Transition to War
  - (2) Seizing the Initiative
  - (3) Carrying the Fight to the Enemy

Figure 3.7 Maritime Strategy Basics.

2. The Basics

a. Peacetime Presence

Sea power is relevant across the spectrum of conflict, from routine operations in peacetime to the provision of the most survivable component for deterring strategic nuclear war. The Maritime Strategy provides a framework for considering all uses of maritime power. Figure 3.8 illustrates the spectrum of conflict and draws attention to the importance of the lower levels of violence where navies are most often the key actors. The **key goal** of the **peacetime strategy** is to further international stability through support of regional balances of power. The ***more stable*** the international environment, the ***lower*** the probability that the Soviets will ***risk*** war with the West. This goal is accomplished through a variety of peacetime operations including naval ship visits to foreign ports and training and exercises with foreign naval forces. [Ref. 46: pp. 7-8]

b. Crisis Response

The heart of the evolving Maritime Strategy is **crisis response.** ***If war*** with the Soviets ***ever comes,*** it will ***probably result from a crisis that escalates out of control.*** The ability to contain and control crises is an important factor in the ability to prevent global conflict. Between 1946 and 1982, in some 250 instances of employment of American military forces, naval forces constituted the principal element of the response in about 80% of the crises. Reasons for selecting naval forces as the instrument of choice for crisis management and deterrence of conflicts include:

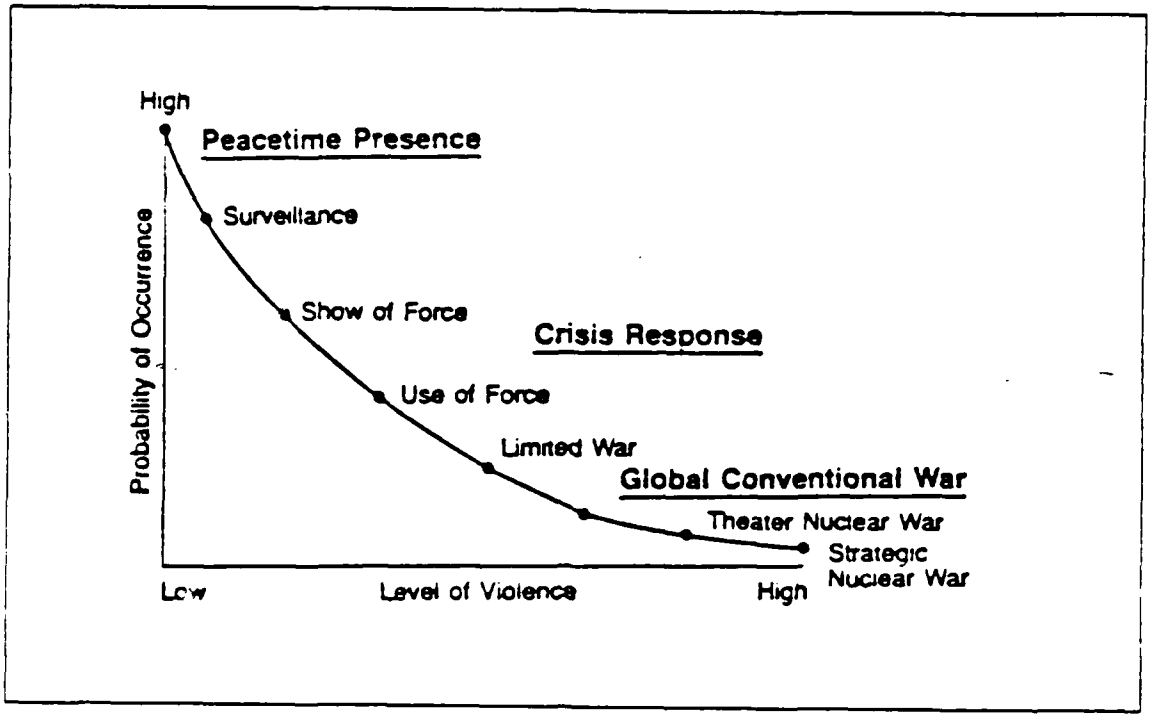

Figure 3.8 The Spectrum of Conflict-Navy.

- Forward-deployed posture and rapid mobility make naval forces readily available at crisis locations worldwide.
- Naval forces maintain consistently high states of readiness because of forward deployments.
- Naval forces increasingly operate with friendly and allied armed forces and the other services.
- Naval forces can be sustained indefinitely at distant locations, with logistics support relatively independent of foreign basing or overflight rights.
- Naval forces bring the range of capabilities required for credible deterrence such as maintaining presence, conducting surveillance, threatening the use of force, conducting naval gunfire or air strikes, landing Marines, evacuating civilians, establishing a blockade or quarantine, and preventing intervention by Soviet or other forces.
- Naval forces have unique escalation control characteristics that contribute to effective crisis control. Naval forces can be intrusive or out of sight, threatening or non-threatening, and easily dispatched but just as easily withdrawn.[23]

[23]The current CNO states: "Operating in international waters, it {the Navy} enjoys the unique advantage of being able to ***signal menace without violating sovereignty***, and once the need is past, of being able to ***sail over the horizon without signalling retreat*** [Ref. 31: p. 14].

If the peacetime presence and crisis response tasks are done well, deterrence is far less likely to fail. Deterrence *can* fail, however, and the next section describes how the Navy would be used in a global war against the Soviets. [Ref. 46: p. 8]

c. Warfighting

Should war come, the Soviets would prefer to use their massive ground force advantage against Europe without having to concern themselves with a global conflict or with actions on their flanks. The key to countering this is to ensure the Soviets will have to face the prospect of prolonged global conflict. The strategy for performing this consists of three phases: ***deterrence or the transition to war, seizing the initiative, and carrying the fight to the enemy.*** There are no fixed time frames associated with these phases: they provide a broad outline of what is to be accomplished. [Ref. 46: p. 8]

(1) *Deterrence or Transition to War.* The initial phase of the Maritime Strategy would be triggered by recognition that a specific international situation has the potential to grow to a global superpower confrontation. The **goal** of this phase is **deterrence.** ***Keys to the success of both the initial phase and the strategy as a whole are speed and decisiveness in national decisionmaking.*** As more functions are transferred to the reserve forces, execution of the President's authority to call up reservists[24] becomes increasingly crucial to successful implementation of the strategy. The United States must be in position to deter the Soviets' "battle of the first salvo" or deal with that if it comes. Even though a substantial fraction of the fleet is forward deployed in peacetime, ***prompt decisions are needed to permit rapid forward deployment of additional forces*** in crisis. The need for forward movement is obvious. This is where the Soviet fleet will be, and this is where the Navy must be prepared to fight. Aggressive forward movement of anti-submarine warfare forces, both submarines and maritime patrol aircraft, will force Soviet submarines to retreat into defensive bastions to protect their ballistic missile submarines. This both ***denies*** the Soviets the ***option*** of a massive, early attempt ***to interdict the sea lines of communication*** and counters such operations against them that the Soviets undertake. [Ref. 46: pp. 8-10]

(2) *Seizing the Initiative.* If war comes, the Navy will **seize the initiative** as far forward as possible. Seizing the initiative is vital for several reasons:

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[24]This call up is currently limited to 100,000. Virtually the entire Navy cargo-handling capability and all Navy combat search and rescue capability, for example, depend on reservists. [Ref. 46: p. 10]

- It demonstrates to the allies the United States' determination to prevail and contributes to alliance solidarity.
- ***The history of war indicates that gaining the initiative is the key to destroying an opponent's forces.***
- Seizing the initiative opens the way to apply pressure on the Soviets to ***end the war on our terms--the new goal*** of the strategy ***once deterrence has failed.***

Seizing the initiative is accomplished through the Navy classic tasks of:

- Antisubmarine Warfare (ASW)
- Antisurface Warfare (ASUW)
- Antiair Warfare (AAW)
- STRIKE Operations
- Counter Command and Control
- Mine Warfare
- Special Operations
- Amphibious Operations
- Sealift

ASW will be conducted to prevent leakage of enemy forces to the open ocean where the Western Alliance's resupply lines can be threatened. ASUW involves carriers, submarines, cruise missile-equipped surface ships, and land-based forces eliminating forward-deployed Soviet surface ships. **AAW** demands ***offense and defense in depth,*** long range indication and warning, long range interception and surveillance, and base neutralization; it is an ***area*** where the ***contribution of the allies and other services*** is particularly ***important*** for the ***overriding goal*** is to counter the Soviets' missile launching platforms: ***to shoot the archer before he releases his arrows.*** Successes in ASW, ASUW, and AAW are crucial to effective prosecution of offensive **STRIKE warfare.** To apply strike capability, carriers must be moved into positions where, combined with the U.S. Air Force and allied forces, they can bring to bear added strength needed on NATO's Northern or Southern flanks, or in Northeast Asia. The strike power of carrier battle forces can also be ***augmented with conventional land-attack TOMAHAWK cruise missiles*** launched from submarines or surface ships. [Ref. 46: p. 12]

(3) *Carrying the Fight to the Enemy.* The tasks in this phase are similar to those of earlier phase, but must be more aggressively applied as war termination is sought on favorable terms to the United States and its allies. The goal would be to complete the destruction of all Soviet fleets which was begun in the second phase.

During this phase, the United States and allies would press home the initiative worldwide, while continuing to support air and land campaigns, maintaining sealift, and keeping sea lines of communication open.

The various tasks in all phases of the Maritime Strategy must be ***implemented simultaneously*** on, over, and under the sea. The forces combine in a synergistic way, both to deter and to win if deterrence fails. The complexity of the tasks makes it essential that the war not be micro-managed from Washington, but rather that options and broad concepts be provided to assist the unified commanders in implementing their detailed plans. Command, control, communications, and intelligence (C3I) combine to form the glue that binds this entire effort together. **Space**[25] ***is an essential factor in command, control, communications, and intelligence.*** The Navy is the number one tactical user of information from space. The information is recovered, fused in real time, and continuously disseminated to all tactical users at sea. Although the importance of space has long been understood intuitively, **the Maritime Strategy clarifies the essentiality of space** for a Navy with global responsibilities. [Ref. 46: p. 13]

3. **The Methods and Resources of Conducting Over-the-Horizon Operations**

a. Methods

Figure 3.9 [Ref. 47] lists the dominant activities and establishes the context for modeling the antisurface warfare (ASUW) and STRIKE mission areas. Even though this description was taken from a research contribution done solely for the ASUW mission area, the author asserts that STRIKE warfare uses some of the same methods and resources to conduct its missions.

The major tasks are to find targets, allocate assigned forces for the attack, and prosecute the engagement. The engagements envisioned involve beyond line-of-sight (BLOS) or Over-the-Horizon (OTH) communications, weapons, and sensors; some of these may not be under the control of the Officer in Tactical Command (OTC). He needs status information from outside. Operations of the enemy and the U.S. task group proceed under basic strategic, tactical, and doctrinal guidelines and in the natural and manmade environments where engagement occurs. An engagement, from assignment of the attack mission until completion of the last attack, may last several days. The process shown in Figure 3.9 is described below:

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[25]"Space" in this context does refer to outer space.

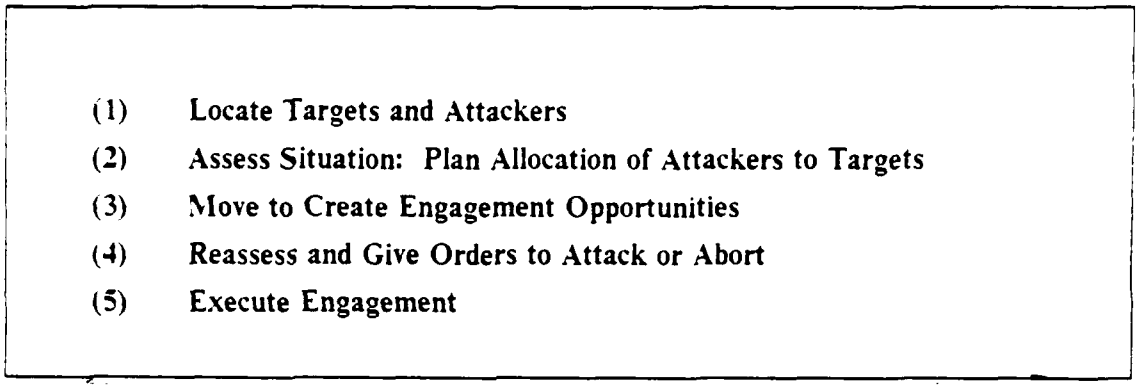

Figure 3.9 The Engagement Process for ASUW.

(1) **Locate Targets and Attackers.** The processing of sensory data (electromagnetic and acoustic emissions and reflections) into raw detection (positions and frequencies) is done by detection systems both inside and outside of the task force. The classification of platform type suffices for assignment of responsibility for action to one of the defensive mission managers (ASW, AAW, ASUW). The identification (friend, foe, or unknown) of a detected entity is equivalent to establishing its intent and is used to decide whether engagement is to take place.

(2) **Assess Situation: Plan Allocation of Attackers to Targets.** The condition of all forces is assessed before, during, and after an engagement. Enemy status may be more difficult to determine; various tactical publications and damage assessment rules must therefore be applied. Planning produces a list (in order of priority) of feasible attack assignments against targets. The choice of a particular plan from among these possible attacks involves an estimate of the possible outcome. After consideration of the externally imposed constraints and strategic objectives, a basic operational plan can be issued.

(3) **Move to Create Engagement Opportunities.** Each attack platform commander is constrained by the operational plan he is given. He then develops his implementation plans in accordance with local conditions and the mobility status and weapon envelopes of his platforms. His planning must take into account countermeasures by the targets and may be based on existing tactical concepts. Eventually, the commander may decide that he either has an engagement opportunity or cannot attain one. This result is reported and is the basis for orders from the OTC.

(4) **Reassess and Give Orders to Attack or Abort.** A change in the status of engagement opportunities (either that they now exist or that they are unattainable) requires the OTC to decide how to act. He must, accordingly, update the effectiveness assessment he made when drawing up his initial plans and adjust the attacker-target pairing assignments. Operational orders are then revised with particular attention paid to the force's defensive posture.

(5) **Execute Engagement.** The attack platform commander is responsible for execution of the attack. Decisions about which weapon to use depend on the availability of the systems; these may be in use for other missions or may be entirely inoperative. In Over-the-Horizon engagements, good data on target-attacker location is crucial for a fire control solution. Similarly, continuous control and monitoring of the launched weapon is tenuous without special sensors. The actual impact of the weapon may or may not be observed, thus making the weapon status information only occasionally available. This information is fed back for assessing engagement results and deciding on a plan for reattack, if needed.

b. Resources

The primary strike assets for attacking land-based OTH targets are aerial and missile weapons systems. The aerial means are carrier based fighter aircraft carrying a variety of munitions and the missile is the TOMAHAWK cruise missile.

(1) *Attack Aircraft.* Carrier based attack aircraft provide the platforms from which a variety of munitions can be launched against OTH land-based targets. Some of the platforms and munitions used in these missions appear in Figure 3.10, with the emphasis again on laser systems and munitions. [Ref. 44]

(2) *TOMAHAWK Cruise Missiles.* The TOMAHAWK cruise missile provides the long-range striking power against surface and land targets previously found only in tactical aircraft. Although the TOMAHAWK is not a substitute for fleet tactical aircraft, it does provide a significant increase in fleet standoff range and firepower. The range of a TOMAHAWK is approximately 250 miles; 60 to 100 TOMAHAWKS are approximately the equivalent of 30 combat loaded A-6Bs. The TOMAHAWK gives the commander convincing options other than the commitment of a carrier. The peacetime presence of a single destroyer on the horizon of a troubled country can provide the same possibility of naval intervention ashore that in the past required the carrier--and her absence somewhere else. It provides a crisis response by permitting precise surgical strikes of specific high-value targets without any possibility of losing U.S. pilots. [Ref. 48: pp. 52-53]

System	Service	Employment Platform	Range
Laser Spot Tracker/Acquisition Systems			
Target Recognition Attack Multi-Sensors (TRAM)	Navy Marine Corps	A-6E	4.5 - 5 miles
Angle Rate Bombing System (ARBS)	Marine Corps	A-4M,AV-8B	Variable
Laser Spot Tracker (LST)	Navy Marine Corps	F/A-18	40° across 14° up 10° down
Target Designation Systems			
Modular Universal Laser Equipment (MULE)	Marine Corps	Ground (Handheld or tripod)	Stationary-5kilometers Moving-3kilometers
Night Observation System (NOS)	Marine Corps	OV-10D	Slant Range/Visib. Dependant
Laser Guided Munitions			
HELLFIRE	Marine Corps	AH-1	5 kilometers
COPPERHEAD	Marine Corps	155mm Howitzer	3-16 kilometers
PAVEWAY I,II, Laser Guided Bombs (LGB)	Navy	Any attack	Up to
PAVEWAY III Low Level Laser Guided Bombs (LLLGB)		or fighter aircraft	6 kilometers
Laser Maverick	Marine Corps	A-4,AV-8 A-7,F/A-18	7 miles across 10 miles ahead
5-inch Semi-Active Laser Guided Projectile	Navy	DD/DDG Class Ships	Classified
AGM-123A Skipper II	Navy Marine Corps	A-6E,A-7 F/A-18	Classified

Figure 3.10 Navy and Marine Corps Platforms and Munitions.

Cruise missiles are basically nuclear or conventionally armed weapons powered by turbofan engines. They fly at subsonic speed (about 0.5 Mach) and are guided, with the exception of one version, by an inertial guidance unit updated by a terrain contour matching (TERCOM) system. This system matches scenes detected on the actual flight path with digital maps stored in the missile's computer. Five types of cruise missiles are currently in production. The air-launched cruise missile (ALCM), ground-launched cruise missile (GLCM), and TLAM/N model of the TOMAHAWK sea-launched cruise missile (SLCM) are nuclear. The other SLCMs are the conventionally armed ***TLAM/C for attacking tactical land-based targets*** and a conventionally armed TOMAHAWK anti-ship cruise missile (TASM) for destroying enemy surface ships and submarines. [Ref. 49: pp. 47-64]

The missiles could be used preceding TACAIR strikes in order to suppress target defenses. This combination could reduce aircraft attrition and increase the level of damage inflicted on the target. There is clearly a tradeoff between using TOMAHAWK and TACAIR. If the "cost" of the mission is driven by expected aircraft attrition rates or the air wing is otherwise engaged, then the TOMAHAWK is an appropriate choice of strike weapon. [Ref. 48: pp. 52-53]

The TOMAHAWK land-attack missiles' candidate targets are generally those considered to be high leverage. TOMAHAWK land-attack missiles are suitable for employment in three general strike roles:

- **Defense Suppression.** Candidate targets include enemy command and control facilities, Surface to Air Missile (SAM) sites, and aircraft on the ground.
- **Surgical Strike.** Potential targets could include power stations, oil refineries, and fuel and munition depots.
- **Interdiction.** Targets could include railyards, bridges, dams, port facilities, and airfields. [Ref. 48: p. 52-53]

E. COMPARISON

A favorable comparison between the Maritime Strategy and AirLand Battle doctrine can be made in several areas. The discussion parallels the order in which the AirLand Battle and Maritime Strategy were previously presented and represents the author's view of the common areas.

1. The Basics

a. Objectives

The objective of all operations in the AirLand Battle is to impose the United States' will upon the enemy--to achieve U.S. purposes. The goal of the overall Maritime Strategy is deterrence--or should deterrence fail--to use maritime power to bring about war termination on favorable terms. Recalling that military strategy is derived from policy, these statements of objectives would appear to be compatible if "U.S. purposes" and "favorable terms" are compatible. The author believes the intent of these phrases in both documents is to emphasize that military operations are undertaken solely to achieve stated policy objectives issued by the civilian political leaders of the country. In this regard, the documents are in harmony.

b. Level of War

Operational art in AirLand Battle doctrine is the employment of military forces to attain strategic goals; it requires "a careful understanding of the relationship of means to ends". The Maritime Strategy is "a design for relating means to ends". The conclusion reached by Commander Bradley in his War College essay would appear to be correct: the basic doctrines are one in the same at the operational level of war. [Ref. 50: pp. 12-14]

c. Tenets

Initiative is the first AirLand Battle tenet. Seizing the Initiative is the second phase in the Warfighting portion of the Maritime Strategy. Agility, as the second AirLand Battle tenet, could be compared on the level of moving forces to where they can influence the battle. The Army has recently recognized the need for lighter forces, with the accompanying ability to move them quickly to where they are needed. The Maritime Strategy emphasizes the need for politicians to allow for early deployment and activation of reserves so that forces can be brought to bear, should they be needed. The combination of these tenets and requirements underscore the absolute need for civilian political leaders to allow for positioning of forces early so that a military response will remain viable; otherwise, the initiative will not be seized and military options will be less than optimal.

Fighting the war in depth and synchronizing joint and combined operations pervade both documents. For the AirLand Battle, the concept of depth is a tenet and is included as an area of operations. In the Transition to War and Warfighting portions of the Maritime Strategy, force projection and "shooting the archer before he

releases his arrows" are key elements of the overall plan to limit the enemy's ability to influence or enter the battle at a later date. Conducting joint deep operations requires synchronization. Both the AirLand Battle and Maritime Strategy acknowledge the need for the other services bringing the enemy under their combined forces' strength. Performing tasks simultaneously on, over, and under the sea requires synchronization in order to prevent fratricide. Bringing four services and their allies together, without fratricide or collateral damage, at the correct place and time to maximize firepower, requires synchronization. Whether expressly called that or not, the requirement for joint deep operations will require synchronization.

d. Area of Operations

Rear battle for the Army contains the Navy's actions to maintain the sea lines of communication (SLOC). The rear battle in a nautical sense can also be thought of in terms of protection of the homeland, where an agreement between U.S. Coast Guard and Navy forces has established Maritime Defense Zones for defense of the United States' contiguous seas. Mine warfare and attack submarine forces will certainly be involved in the rear battle, protecting territory and supply lines.

Deep operations in the AirLand Battle seek to disrupt the enemy's operational tempo and delay follow-on forces from entering the battle. Areas of interest and influence are described in terms of time more than in terms of geography. The deep battle at sea will concern itself with the attacking of opposing naval forces before they can brought to bear on U.S. naval forces and destroying naval supply lines and depots. Carrying the Fight to the Enemy is operationally similar to Deep Operations; the characteristics of high leverage targets, distances between the main force and these targets, the processes used to engage these targets, and the weapons systems used to prosecute the engagements are all similar. The comparison is continued below of the methods and resources for conducting deep battle and over-the-horizon missions. [Ref. 50: pp. 12-14]

2. **Methods and Resources**

a. Methods

Figure 3.11 [Ref. 51: p. 25] shows the elements of a basic Command and Control (C2) process model. These elements will be used to compare the processes of J-SAK targeting and ASUW/STRIKE engagements. The purpose of comparing the targeting and engagement processes with the generic C2 process is to highlight the similarities and insure no important function has been omitted.

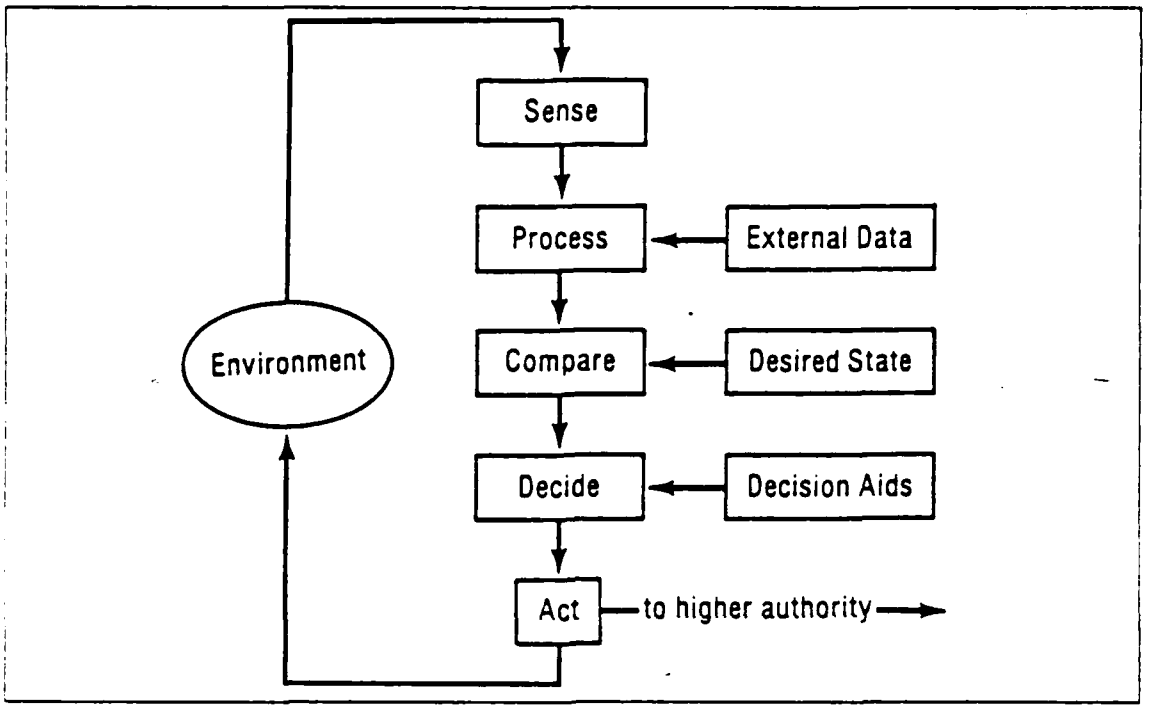

Figure 3.11 Command and Control (C2) Model.

The SENSE function corresponds to all data-gathering activities. It is concerned with extracting signals from the environment. The PROCESS function acts upon these signals to attempt to extract meaning from them. External data not directly from the environment may be used. These may include intelligence analyses indicating patterns representative of division headquarters, etc. The PROCESS function produces event reports and status reports for use by later functions. The COMPARE function compares the state of the environment, as determined by reports from the process function, with a desired state as specified by some external source. Based upon this comparison, the DECIDE function determines what should be done to move the actual state to the desired state and the ACT function executes that decision. [Ref. 51: pp. 23-46]

Figure 3.12 shows the side-by-side comparison of the C2, J-SAK targeting, and ASUW STRIKE engagement processes. All functions appear in their original order. However, since the functions do not appear in the C2 process order, *underscored* functions are placed besides their corresponding C2 function in the diagram. Similar functions performed by different services at different locations could be combined, if it was considered desirable or necessary. Even though there is not a

one for one match to each other, all functions have been included and represent an opportunity for joint cooperation at each level. The "feedback" loop of Figure 3.11 would represent the assessment process after an engagement to determine the need for further action. The comparison with a generic C2 model demonstrates the similarities and that no important function has been overlooked in these processes.

C2 Process	J-SAK Process	ASUW/STRIKE Process
	Establishing Objectives and Priorities	
SENSE	Collecting Information	Locate Targets and Attackers
	Detection	
PROCESS	Location	*Locate Targets and Attackers*
	Identification	
COMPARE	*Establishing Objectives and Priorities*	Assess Situation, Plan Allocation of Attackers to Targets
		Move to Create Engagement Opportunities
DECIDE	Decision	*Move to Create Engagement Opportunities*
		Reassess and Give Orders to Attack or Abort
ACT	Execution	Execute Engagement

Figure 3.12 Comparison of C2 Model and the Engagement Processes.

b. Resources

As explained previously, the emphasis on resources was on laser systems and munitions. Figures 3.6 and 3.10 were extracted from a joint publication on laser designation of targets. Obviously, there are other resources available for the prosecution of deep targets. The opportunities for joint cooperation appear to the

author to lie primarily in prosecuting land-based deep targets with TACAIR resources of all four services. Transitioning to the last chapter, CBRS requires some foundation on which to derive military requirements. The joint doctrine on laser designation establishes this foundation. The resources used to engage deep and OTH targets were purposely displayed to highlight the similarities. This provides a vehicle for discussion in the final chapter of a space-based laser designator.

F. SUMMARY

This chapter contains the materiel used to establish a general and specific context in which space system support will be examined in the next chapter. The 1986 AirLand Battle doctrine provides the general context for the Army and Air Force interplay in performing missions; the 1986 supplement to the U.S. Naval Institute's *Proceedings* provides the general context for Navy and Marine Corps interplay in performing missions. Within these general contexts, the methods and resources used to perform the Joint Attack of the Second Echelon (J-SAK) and attack of land based targets at Over-the-Horizon (OTH) ranges are explored. After reviewing J-SAK and OTH, a comparison of the AirLand Battle and Maritime Strategy showed that:

- The AirLand Battle and Maritime Strategy objectives are to achieve the stated policy objectives issued by civilian political leaders of the country.
- The doctrines are compatible at the operational level of war.
- The fundamental principles of AirLand Battle appear as four tenets and are reiterated or reinforced in different forms throughout the Maritime Strategy.
- Activities in one services' area of operations may be included in another services' area of operations. Opportunities for joint cooperation appear to lie in prosecuting land-based deep targets with TACAIR resources of all four services.

With the ground work now established, the four CBRS areas of mission, historical perspective, threat, and technological forecast will be used to provide an analysis of a space-based laser designator.

IV. AN EXAMPLE OF THE CBRS PROCESS

A. INTRODUCTION

1. A Command and Control View of the Laser Designator Function

Laser designators act as an interface device. Recall from Chapter III the generic Command and Control (C2) model (Figure 3.11). A human being (a spotter) or electronic sensor sees a target (SENSE) and relays the grid coordinates of the target to an organization whose has the responsibility to PROCESS, COMPARE, and DECIDE what should be done. If an attack aircraft with laser guided munitions is selected to engage the target (ACT), a spotter acts as the final controller of the engagement because he **designates** the target with laser energy. The image the spotter observes is translated into laser energy which the laser guided munitions sense. The designators acts as an interface device between the SENSE and ACT functions.

It is important to interface the detecting sensor with the engaging munition. If the target is detected by an emission of signals (through Communications Intelligence--COMINT or Electronics Intelligence--ELINT), and if the attacking weapon is a missile which seeks that kind of emission (a High-Speed Anti-Radiation Missile--HARM), then the engagement is compatible. If the target is spotted by a person or through Imagery Intelligence (IMINT), then the engagement weapon must either lock onto that image (which requires the spotter to continuously sight on the target) or be translated into a form that the weapon platform and weapon can use to engage the target (grid coordinates or laser designated energy).

2. Why a Space-Based Laser Designator

As stated in Chapter II, even when specific deficiencies do not exist, technological opportunities should be explored that may enhance a mission area. It is possible that the research being done on lasers for the Strategic Defense Initiative (SDI) could provide a technological opportunity that would benefit the terrestrial use of laser guided munitions. The example chosen to illustrate the CBRS process is a space-based laser designator. Some of the other reasons for this selection are listed below:

- Prior studies of space-based laser designators have not been found. No ongoing work is being conducted or has been proposed for this idea. It therefore allows an unclassified discussion without violating any security classifications.

- The space mission which would be performed by a space-based laser designator is a force application mission. Since the audience for this paper might not be aware of the military space missions, this example gives an opportunity to discuss them.
- Joint doctrine does exist on joint laser designation of targets. The example provides a vehicle to discuss the four areas of mission, threat, historical perspective, and technological forecasts and have a joint, doctrinal base on which to show the relationship between mission requirements and space limitations.
- Not all space systems have the treaty implications that a space-based laser designator would generate. This provides a vehicle to examine the political and pragmatic dilemma of conforming to treaty specifications while meeting the needs of national security.
- It has been speculated that the ultimate goal of SDI is to attack ground targets. This will examine one aspect of that argument.
- Work has been and is being done on space lasers. Information is available to discuss the technological considerations of this idea as part of the CBRS process.

3. Organization of this Chapter

The four areas that will be examined are highlighted in Figure 4.1. The purpose of this examination is to demonstrate the CBRS process on a space-related example. In the interest of brevity, it is not intended as an in-depth review or a comparison of alternate methods of performing the same mission with different, terrestrial assets. By considering the mission, historical perspective, threat, and technological aspects of a space-based laser, the limitations imposed on any space application will hopefully be surfaced. Space systems should be considered when the systems can meet mission requirements for a combination of lower cost or higher performance than can other systems. By following the CBRS process, these limitations can be viewed along with the advantages of using space-based assets.

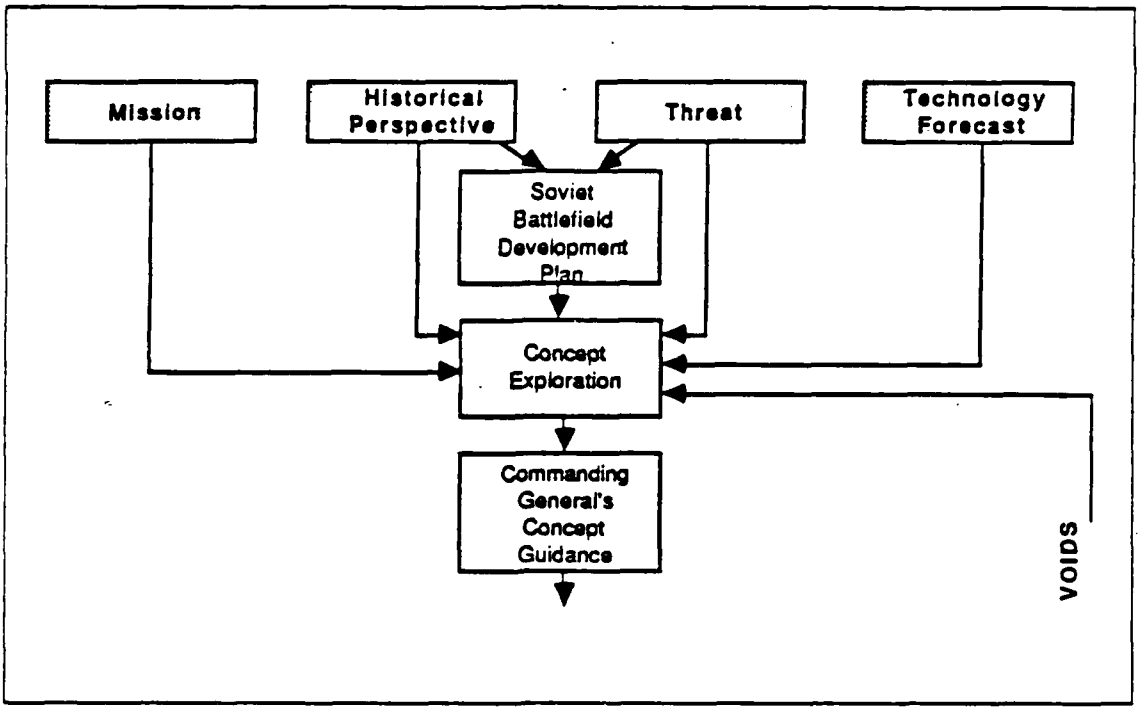

Figure 4.1 CBRS Areas to be Covered in this Chapter.

B. MISSION

1. Military Space Missions

Military space missions are broken into categories as shown in Figure 4.2 [Ref. 52]. Space operations are performed to accomplish space missions. **Space operations** is a broad generic term descriptive of a wide range of actions and activities performed by space systems to accomplish military objectives. Space operations are associated with:

- Preparation for launch.
- Launching, on-orbit operations and support.
- Satellite surveillance and warning, controlling spacecraft, and recovering earth-orbital and extra-earth-orbital vehicles.
- Terrestrial activities that command, control, support, sustain, and surveil spacecraft between launch and mission termination.

A description of the basic space missions accomplished by space operations follows.

a. Force Enhancement

By far the largest number of current military space missions are performed in the area of force enhancement. Force enhancement is a combat-support mission

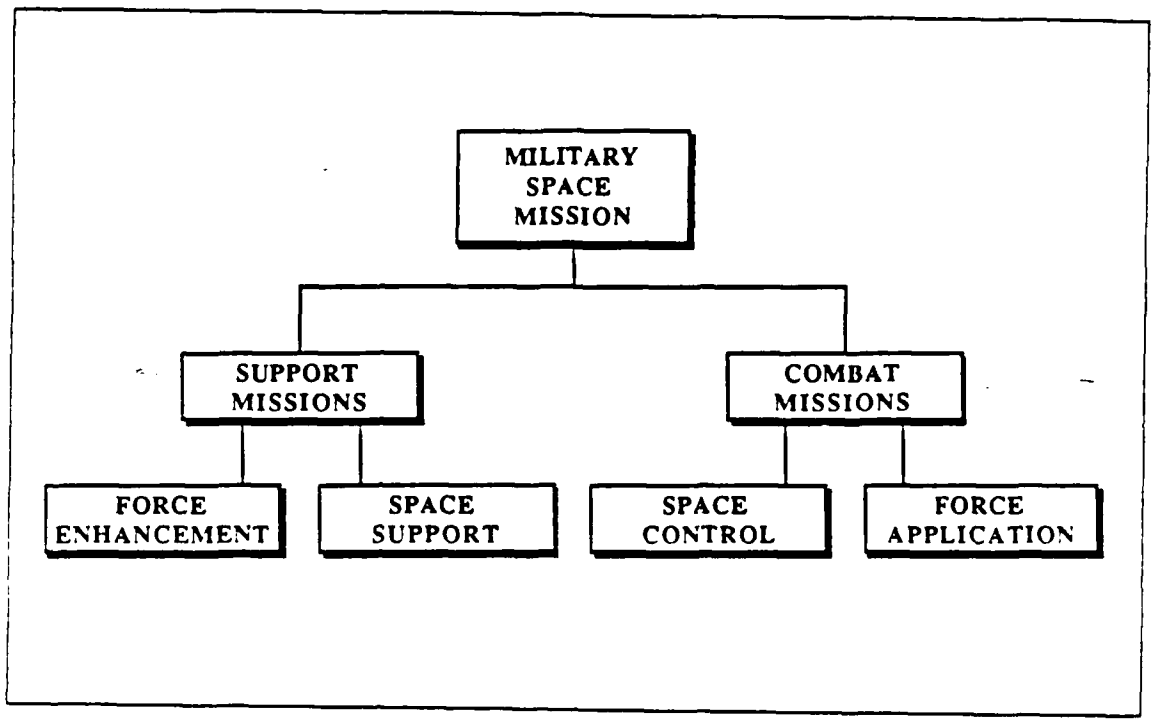

Figure 4.2 Military Space Roles and Missions.

area involving the use of space systems to improve the effectiveness of military forces. Below are listed some of these support functions with an example (if available):

- Communications. MILSTAR-advanced communications satellite.
- Navigation. GPS-Global Positioning System.
- Terrestrial Surveillance. DSP-Defense Support Program.
- Terrestrial Targeting.
- Space Surveillance. SPADATS-Space Detection and Tracking System.
- Mapping, Charting, and Geodesy. LANDSAT- Land-use satellite.
- Environmental. DMSP-Defense Meteorological Satellite Program.
- Search and Rescue. SARSAT-Search and Rescue satellite. [Refs. 52,53: n.p., pp. 33-39]

b. Space Support

Space support is combat-support mission area involving all necessary prelaunch preparations and activities involved with deploying and sustaining space systems. It includes such functions as:

- Space Launch and Recovery. The preparation, buildup, launch, deployment and (if necessary) retrieval of space systems as well as the space transporter.

- Orbit Transfer. Operations involving the use of propulsive stages to maneuver satellites from their initial orbit to their final mission orbit.
- On-orbit Control. Operations to plan, train, direct, and sustain deployed military space systems.
- Management, planning, and operations support activities. These include manpower, training, safety, education, and logistics support. [Ref. 52]

c. Space Control

Space control is a combat mission area providing freedom of action in space for friendly forces while denying it to the enemy. It embodies the concept of "space superiority" and consists of two parts:

- Counter Space Operations. These are spaceborne or terrestrial operations conducted to gain or maintain control of and dominance over the space medium. Included are measures to ensure that friendly space forces have freedom of action through the space medium. This is carried out by nullifying the enemy's offensive and defensive space capabilities.
- Space Interdiction. This function is conducted against the enemy's space lines of communication (Space systems used to support or participate in military operations) which could be used to support operations against friendly forces. [Ref. 52]

d. Force Application

Force application is a combat mission area conducted from space against terrestrial (land, sea, air) targets with the objective of influencing a terrestrial conflict. Force application missions from space could encompass strategic offense and defense, interdiction of enemy forces and close support. [Ref. 52]

The purpose of this discussion was to familiarize the reader with the possible missions which could be performed by the military. A space-based laser designator would appear to fall into the category of force application. To the author's knowledge, no programs currently perform within the definition of force application; laser designation from space would definitely fill this void.

2. Joint Doctrine on Laser Designation of Targets

One of the areas where definitive joint doctrine does exist is in the area of laser guided munitions. *Joint Laser Designation Procedures* is a 525-series pamphlet which provides the joint tactics, techniques, and procedures for employing laser designators with acquisition devices and laser guided munitions. It was written to be used by the US Air Force Tactical Air Command (TAC), US Army Training and Doctrine Command (TRADOC), US Atlantic Fleet (LANTFLT), and Marine Corps Development and Education Command (MCDEC) to teach joint laser procedures. It

may also be used by joint and service component forces to conduct joint laser training and operations. It was written to be applicable to U.S. Readiness Command (REDCOM) forces during training, exercises, and contingency operations. [Ref. 44: pp. i-ii]

Recall from Chapter III that the primary means to attack deep targets for the corps is through the use of attack aircraft. The STRIKE mission of the Navy and Marine Corps use fighter aircraft to attack land-based or sea-based targets at over-the-horizon ranges. The laser systems and munitions that can be used for these missions were shown in Figures 3.6 and 3.10 and were extracted from this pamphlet.

Four requirements exist for using the laser target designator resources of the services against deep or over-the-horizon targets. These requirements are shown in Figure 4.3.

- **The pulse repetition frequency (PRF) code of the laser designator and the Laser Spot Tracker (LST) or Laser Guided Weapon (LGW) must be the same.**
- **An agreed upon direction of attack is necessary, because the LST or LGW must be able to "sense" sufficient laser energy reflected from the target being designated.**
- **The laser designator must be designating the target at the correct time.**
- **The delivery system must release the weapon within the specific weapon's delivery envelope.**

Figure 4.3 Requirements for Using Laser Systems.

Laser designators emit a very narrow beam of infrared (IR) energy. Although IR energy cannot be seen with the naked eye, its energy beam and spot are similar to that of a narrow pencil-like beam of light. Laser seekers look for laser designator energy on a specific pulse repetition frequency (PRF) code. Designators and seekers must work together as a team on a specific code, so that seekers will not detect or interfere with designators set on other codes. The designator and seeker pulse codes use a truncated decimal system of three and four digit codes which correspond to specific PRFs. The lower the code number, the faster the laser pulse rate. The faster

pulse rates give the seeker the most opportunity to acquire the target in the time it is available, but requires more power. The requirement to operate on different PRFs would require a space-based laser to have the capability of switching PRFs and the power to sustain the lower code higher frequency pulses. [Ref. 44: pp. 51-54]

The other three requirements impose limitations on a space-based laser designator's orbit. Figure 4.4 illustrates the engagement fan possible for a satellite passing over a target. The target must be in the laser's field of view and oriented such that an attacking system would receive the laser's reflected energy. The orbital parameters would tend to dictate the times that engagements could be conducted and when the laser would be turned on. The platforms which carry the munitions (listed in Figures 3.6 and 3.10) would have to know the direction of satellite passage and the approximate position of the target to release the munitions within the weapon's delivery envelope.

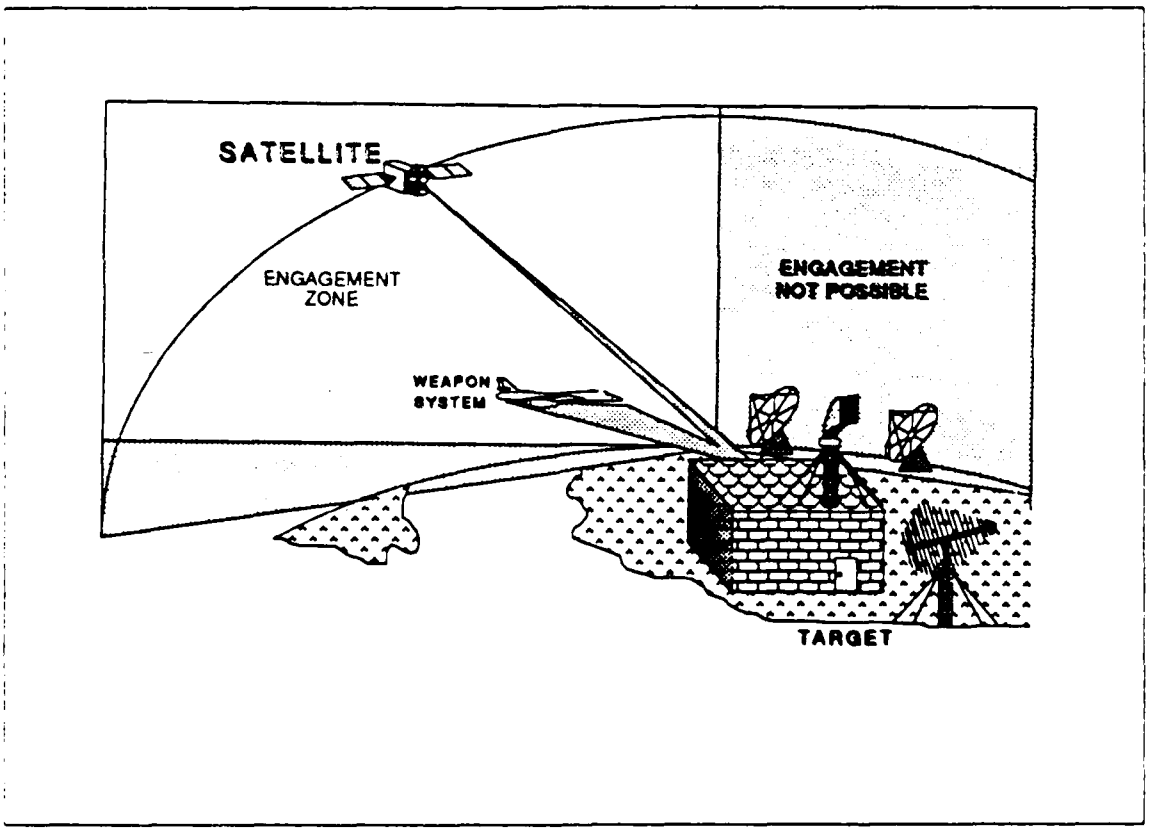

Figure 4.4 Geometry of Engagement.

C. HISTORICAL PERSPECTIVE

1. Space Related Treaties

Any discussion of space systems must include a discussion of the treaties which impose restrictions on the use of space systems. Figure 4.5 [Ref. 54: pp. 132-134] presents the pertinent treaties and limitations which could limit the deployment of a laser designator in space.

1967 Outer Space Treaty

1. Outer space, including moon and other celestial bodies, are free for exploration and use by all states without discrimination.
2. Outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, use or occupation, or other means.
3. Space activities shall be conducted in accordance with international law, including UN charter.
4. Moon and other celestial bodies are to be used exclusively for peaceful purposes.
5. Prohibited activities:
   a. Nuclear weapons and other weapons of mass destruction (e.g., chemical, biological) not to be:
      - Orbited around earth.
      - Installed on celestial bodies.
      - Stationed in outer space in any other manner.
   b. On celestial bodies, it is forbidden to:
      - Establish military bases, installation, and fortifications.
      - Test any type of weapon.
      - Conduct military maneuvers.
6. Use of military personnel for scientific research or other peaceful purpose is permitted.
7. Requires international consultations before proceeding with activities which would cause potentially harmful interference with activities of other parties.

Figure 4.5 Summary of Space Treaties.

1968 Agreement on Rescue of Astronauts and Return of Space Objects

1. Provides for rescue and return of astronauts who land in territory of a party or a non-national area.
2. Provides for return to launching state of space objects which are found outside its territory. Launching state required to provide identifying data and take steps under direction and control of finding party to eliminate range of harm from hazardous or deleterious space objects.

1971 Agreement with USSR on Measures to Reduce Risk of Nuclear War

- Obligates each party to notify other party of detection by missile systems of unidentified objects or signs of interference with missile warning systems or related communications facilities, if such occurrences create risk of nuclear war.

1972 Convention on International Liability for Damage Caused by Space Objects

1. Launching state absolutely liable for damage on earth or to aircraft in flight caused by its space object.
2. Liability for damage caused by a space object to another space object or to persons or property on board such a space object, anywhere except on surface of earth, is determined by fault.

1972 ABM Treaty with USSR

1. Prohibits deployment of ABM systems or components except as specifically authorized in the treaty.
2. Prohibits development, testing, or deployment of space-based ABM systems or components (prohibition does not apply to research and development of space-based ABM systems preceding field testing).
3. Prohibits giving non-ABM missiles, launchers, or radars capabilities to counter strategic ballistic missiles or elements in flight trajectory and testing in ABM mode.
4. Prohibits deployment in future of radars for early warning of strategic ballistic missile attack except along periphery of national territory and oriented outward.
5. Prohibits interference with national technical means of verification operating consistent with generally recognized principles of international law.

Figure 4.5 (cont'd.)

6. Prohibits deliberate concealment measures which impede verification by national technical means of compliance with the treaty.

1975 Registration of Space Objects Convention

1. Requires a party to maintain a registry of objects it launches into Earth orbit or beyond.
2. Information on each registered object must be furnished to UN as soon as practicable, including basic orbital parameters and general function of the space object.

1980 Environmental Modification Convention

- Prohibits military or other hostile use of environmental modification techniques as means of destruction, damage, or injury to any other State Party if such use has widespread, long-lasting or severe effects.

Figure 4.5 . (cont'd.)

2. **Space-Based Power**

As can be seen in Figure 4.5, there are currently no treaty restrictions on the use of nuclear power in space. The United States has typically used batteries, solar cells and fuel cells as the primary sources of power for its spacecraft in earth orbit. While the Soviets have used nuclear power for some high power requirements, the United States has resisted the use of nuclear power in space except for long range probes which use radioactive isotopes for power. It is the author's opinion that this trend will probably continue. Figure 4.6 [Ref. 55: Fig. IV.A-22] shows the electrical power output and mission duration of various power supplies available for space applications. Assuming that the historical trend continues and that the space-based laser would have a mission duration in excess of a month, solar cells could provide up to 5 kilowatts of power. This power would operate the laser and other subsystems of the spacecraft. [Ref. 53: p. 36]

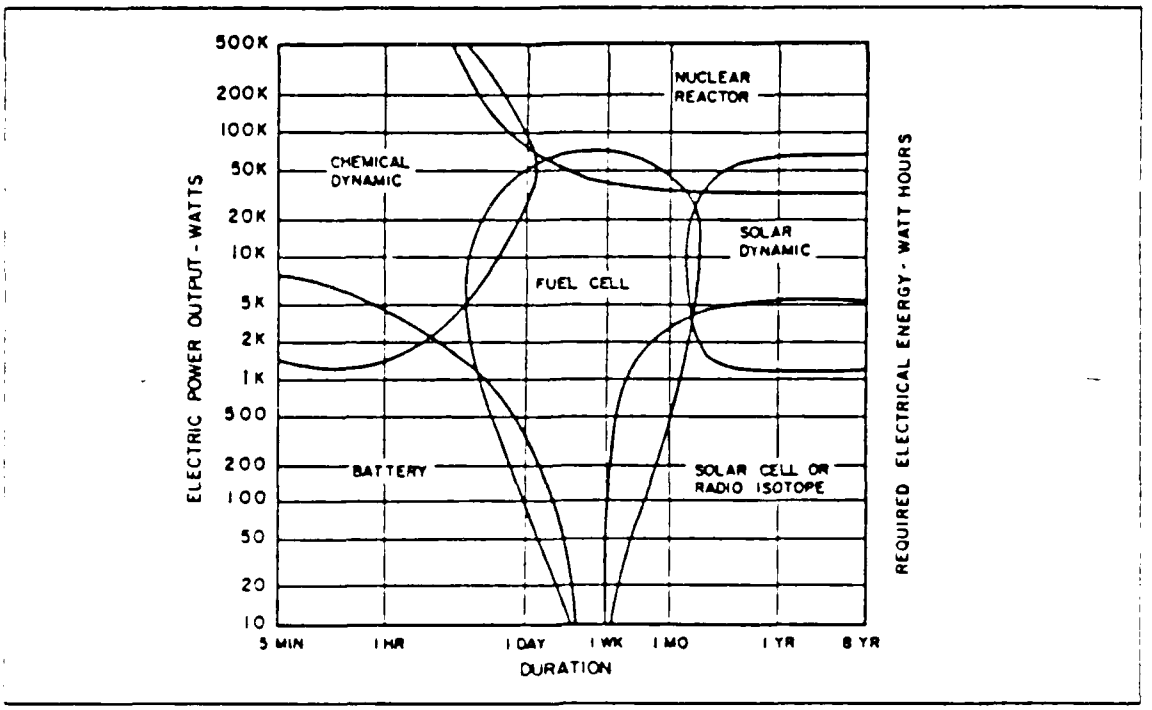

Figure 4.6 Power Supply Operating Regimes.

D. THREAT

As mentioned in the introduction of the thesis, the limitation of keeping the document unclassified forces a somewhat imprecise discussion of the threat. The following discussion of the enemy use of laser countermeasures was taken from *Joint Laser Designation Procedures* [Ref. 44].

> The Soviet Union and its Warsaw Pact allies are the best equipped forces to detect and counter the increasingly sophisticated laser designator and guidance systems used by the armed forces of Western nations. The Soviets believe precision guided munitions (PGMs), specifically advanced anti-tank guided missile systems, are one of the most significant threats to their armored vehicle inventory. Within the last 10 to 15 years, NATO, particularly the United States, has become increasingly dependent upon PGMs to balance the growing numerical superiority of Warsaw Pact conventional forces. A significant number of these advanced weapons employ laser guidance and electro-optic sensors. The Soviets have long recognized that effective laser countermeasures are readily available and relatively inexpensive. Warsaw Pact open literature has made continuing reference to the capability of natural and man-made obscurants to significantly degrade laser systems and night vision devices. [Ref. 44: p. 4]

The Soviets are known to be great users of battlefield obscurants to defeat the weapons systems dependant on laser energy. The environmental restrictions on lasers will be discussed in the next section. It is sufficient at this stage to acknowledge that smoke, dust, and chemical particles in the air may attenuate or reflect the laser beam, thereby preventing sufficient energy reflection from the target for lock-on by laser spot trackers or laser guided weapons. When using obscurants, however, the obscurant is usually placed in the line of sight between enemy forces and friendly forces; it is not placed over the force which is using them. A space-based laser would force a use of obscurants in a manner for which they were never designed to be used. [Ref. 44: p. 14]

While defeating the enemy's countermeasures of lasers, another threat is encountered in space. The following excerpt was taken from a report on *Anti-Satellite Weapons, Countermeasures, and Arms Control* performed by the Office of Technology Assessment [Ref. 53].

> The Soviet Union has been conducting a series of tests of coorbital satellite interceptors ("killer satellites") since 1968. The Department of Defense estimates that these anti-satellite weapons became operational in 1971. These weapons are believed to be capable of attacking satellites at altitudes up to 5000 kilometers or even higher, depending on their orbital inclinations, i.e., very different from the latitude of the interceptor launch site. As of 1984 there appeared to be only two launch pads for Soviet coorbital interceptors, both located at the Tyuratam launch complex. Several interceptors could be launched per day from the complex. [Ref. 53: p. 52]

As the limitations of lasers are examined in the next section, it will become apparent that a space-based laser designator would be susceptible to this threat. [Ref. 53: pp. 49-91]

E. TECHNOLOGICAL FORECAST

The Concepts Based Requirements System recommends that even when a specific deficiency does not exist in an area, technological opportunities for improving a mission area should be explored. When the Army Space Initiatives Study (ASIS) was conducted in 1985, the various proponents for the mission areas in Figure 2.1 were given the task of determining what space technology could do for them in their respective areas. Having worked in the area of Concepts and Studies within a Combat Development Directorate, it appears to the author that the ASIS became a collection of current MAA deficiencies with a best guess estimate of where space might help solve the deficiencies. Some of the officers responsible for estimating the potential

applications of space systems had as much space training as the author had prior to attending this curriculum--little or none. Assuming that manning is approximately the same as in 1984, the ASIS was competing for the project officers' time with other assignments considered more important (Light Infantry Division actions, for example). Therefore, the speculation may not have been as accurate as it could have been.

Space provides the advantages of covering great distances, assess to restricted regions without violating sovereignty, and timeliness if enough satellites are deployed. The purpose of this section is to examine what a space-based laser can and cannot do if deployed. In this way, some of the limitations of space-based systems in general become apparent.

1. **Environmental**

The atmosphere contains a number of constituents which hamper the transmission of a laser beam. Figure 4.7 [Ref. 56: p. 20] shows the transmission of energy through the atmosphere in the various electromagnetic spectrum bands. Note that transmission occurs in "windows" in the atmosphere. These windows permit a laser beam to propagate from space to the ground. Another point to note is that clouds severly attenuate laser beams in the visible and near infrared spectrum because of their water content. The parts of the electromagnetic spectrum most often used for self-contained guidance systems are reproduced from *Precision Guided Weapons* in Figure 4.8 [Ref. 56: p. 18]. Since the wavelengths used for laser guided munitions are normally in the near infrared and infrared regions, the laser beam does not penetrate clouds; it is essential then that the worldwide cloud coverage be considered to determine when a laser designator from space can be used. Figure 4.9 [Ref. 55: Figure II.B-7] shows the seasonal worldwide average daytime cloudiness. The Middle East area appears to have an average of 0-50% sky cover for the entire year. Other areas of interest, such as the Soviet Union and Europe, average greater that 50% cloud cover in all seasons.

2. **Power**

Nothing stops the development of a program faster than a restriction that prohibits the testing or could be interpreted to prohibit the employment of the system. As stated in the historical perspective section, treaty restrictions do not limit the use of nuclear power in space. In the case of a space-based laser, an interpretation could be made that the use of nuclear power in a laser designator makes that designator a nuclear weapon and thus be prohibited by the Outer Space Treaty of 1967. This

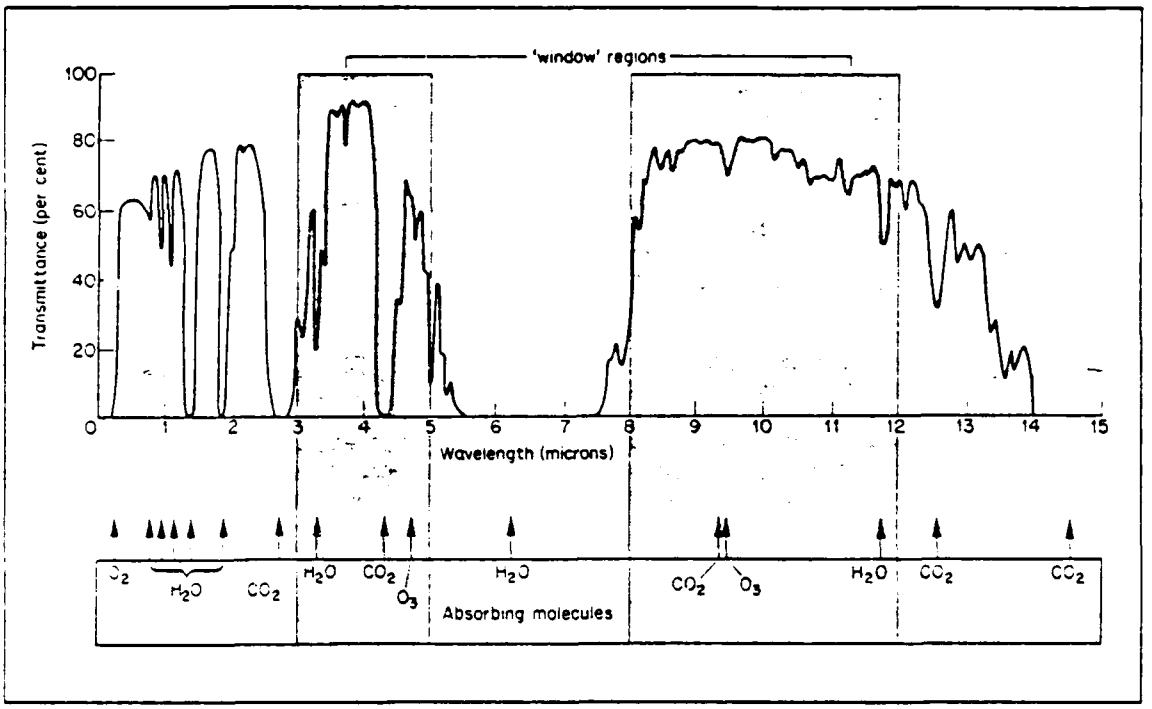

Figure 4.7 Atmospheric Transmission for the Electromagnetic Spectrum.

- Infrared: approx. 0.9 microns (0.9×10^{-6} meters), 3-5 microns, and 8-14 microns.

- Millimeter (10^{-3} meters) wave: around 8.6 mm (35 GHz), 3.2 mm (94 GHz), and 2.1mm (140 GHz)

- Other Microwave: 3 cm (10^{-2} meters) (10 GHz), 6 cm (5 GHz), and 10 cm (3 GHz).

Figure 4.8 Electromagnetic Spectrum for Self-Guided Munitions.

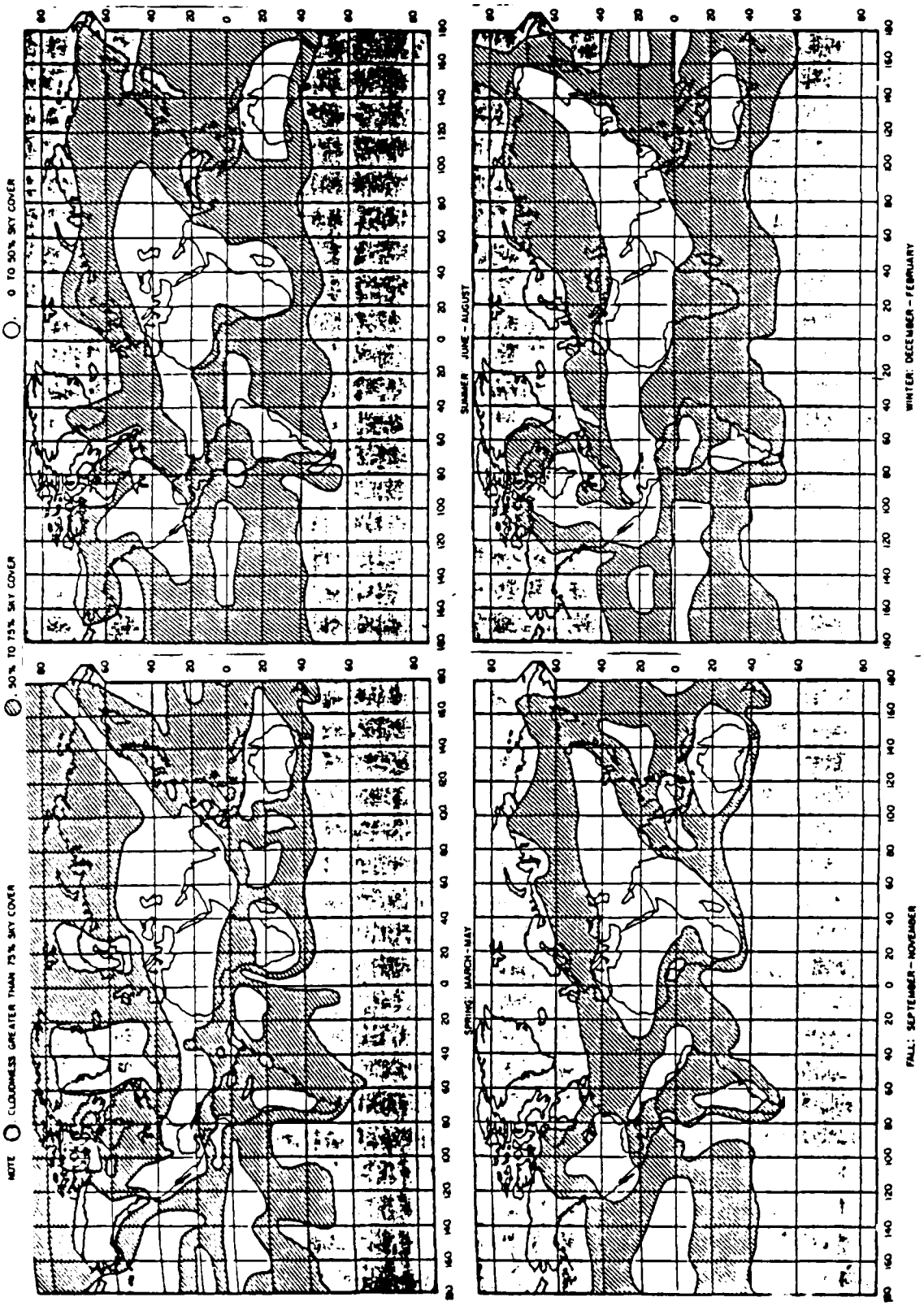

Figure 4.9 Seasonal Worldwide Average Daytime Cloudiness.

somewhat stretched interpretation and historical avoidance by the United States of nuclear power in earth orbit would seem to restrict the total power of the laser designator system to 5 kilowatts. This assumes a mission duration in excess of one month and the use of solar cells (Figure 4.6).

3. **Pointing Accuracy**

In 1981, the National Aeronautics and Space Administration (NASA) conducted a symposium on space laser power transmission. At the time of the symposium, state-of-the-art aiming capabilities were estimated to be approaching the precision required for point-to-point transmission for ranges comparable to Earth-Moon distances. Skylab telescopes had a pointing accuracy of 4.9 microradians.[26] Current SDI objectives require a pointing accuracy of less than one microradian and this has been NASA's goal in developing large space telescopes and for the transmission of space laser power. Figure 4.10 [Ref. 57: p. 144] shows a NASA assessment done in conjunction with the symposium which showed the status of space laser applications and possible applications among civilian and military missions. The figure shows that the intermediate and advanced technology needed for anti-satellite, satellite defense, and destruction of ballistic boosters and airborne targets, can be applied to a space laser system to destroy surface targets. A space-based laser designator could reap the benefits gained in SDI of the pointing accuracy technology. [Ref. 57: p. 19]

4. **Spot Size**

The spot size for the standard target listed in *Joint Laser Designation Procedures* is 2.3 meters by 2.3 meters [Ref. 44: Appendix A]. The wavelength of a laser establishes some fundamental constraints on the optics that can be used with the laser. By far the most important is the Fraunhofer diffraction limit, which determines how small a spot the beam can form. In this case the spot size is measured as an angle (as viewed from the laser) that is proportional to the ratio of wavelength to the diameter of the focusing optics (mirrors). The theoretical formula for the ideal case is shown in Equation 4.1.

$$\text{Spot size (in radians)} = \frac{1.22 \times \text{Wavelength}(\lambda)}{\text{Optics Diameter}(D)} \qquad \text{(eqn 4.1)}$$

The formula can be altered to give spot size in meters as shown in Equation 4.2.

[26]Micro is 10^{-6} and one radian equals 57.3°

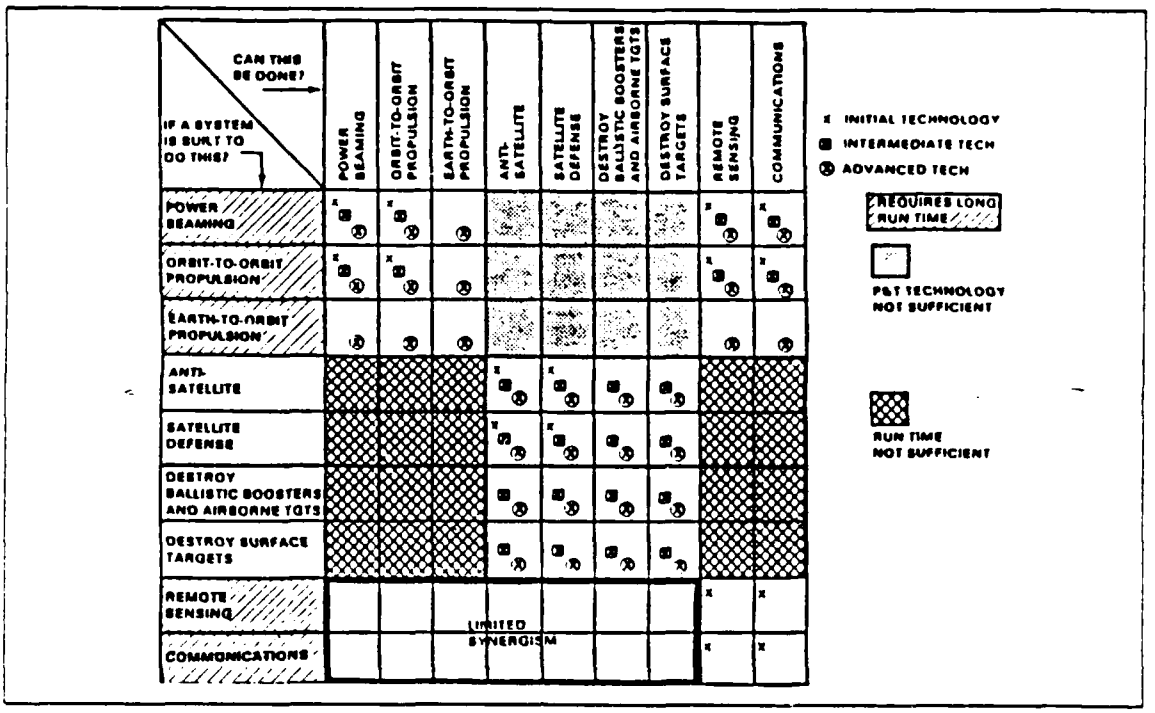

Figure 4.10 Synergisms Among Space Laser Applications.

$$\text{Spot size (in meters)} = \frac{1.22 \times \text{Wavelength}(\lambda) \times \text{Target Distance}(R)}{\text{Optics Diameter}(D)} \quad \text{(eqn 4.2)}$$

Figure 4.11 shows this situation for the standard target; Figure 4.12 shows the tradeoff between mirror diameters, altitude of the orbit, and the wavelength of the laser. The curves are plotted for the wavelengths currently used in laser and precision guided munitions listed in Figure 4.8. It is important to realize that the largest mirror in the United States is the Mount Palomar Observatory with a diameter of 5 meters, the largest one in the world is 6 meters in the Soviet Union, and the largest one yet designed and built for use in space is the 2.4 meter mirror for NASA's space telescope. It would appear that the limitations of mirror diameters and the desire to use the current PGM wavelengths would keep the orbital altitude of a space-based laser designator below 2500 kilometers. Recall from the Threat section that this altitude is within the threat window of the Soviet ASAT. [Ref. 58: pp. 85-113]

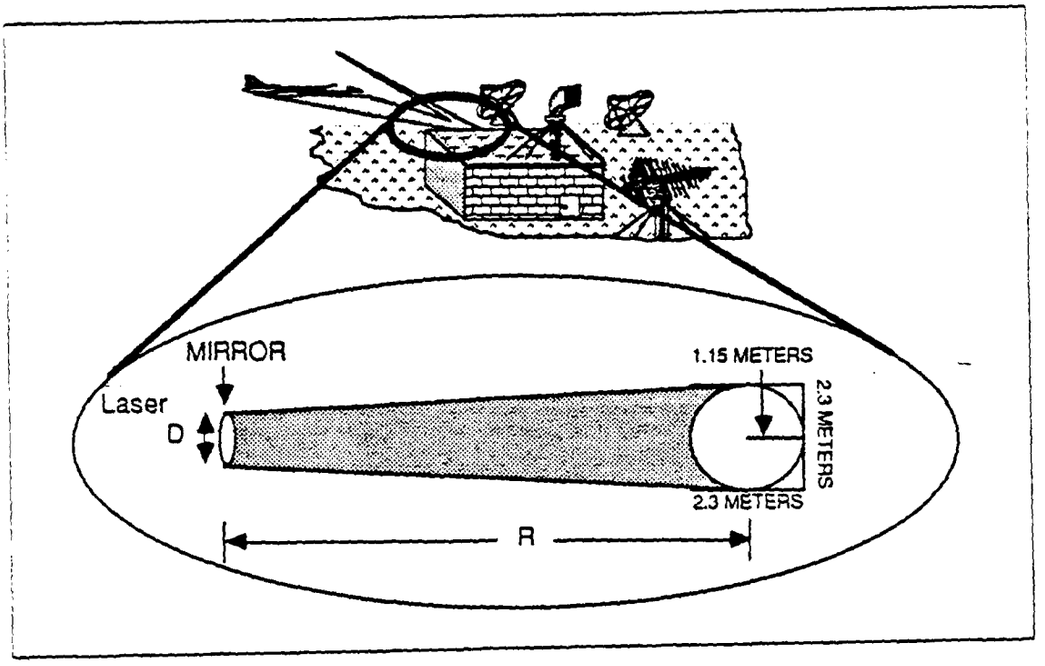

Figure 4.11 Spot Size for a Space-Based Laser Designator.

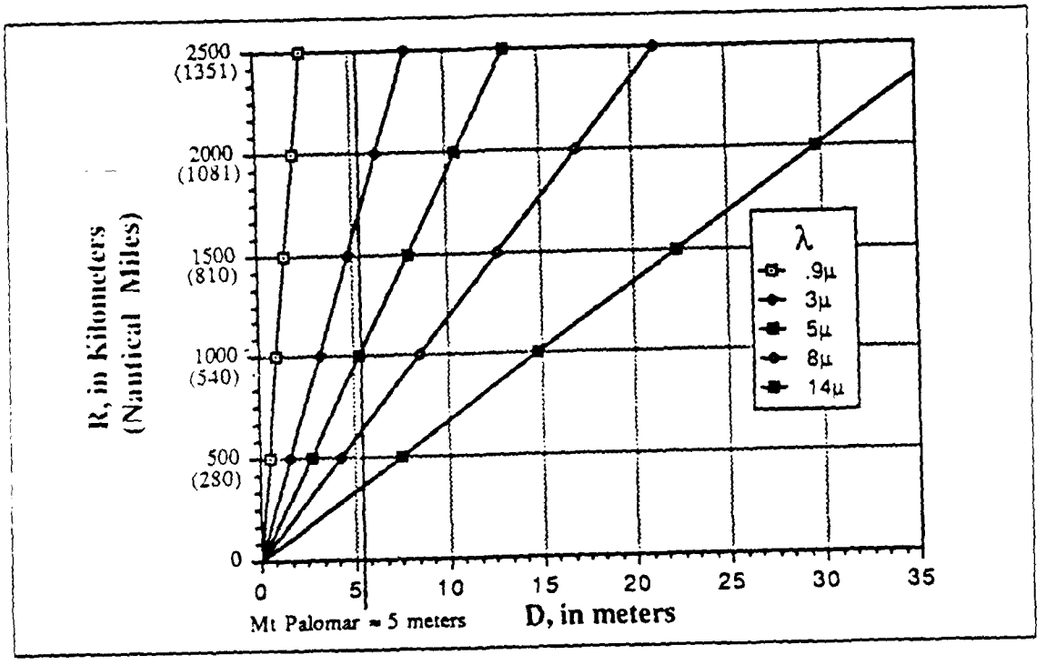

Figure 4.12 Altitude vs. Mirror Diameters for a Space-Based Laser.

5. **Timeliness**

The orbital parameters determine the coverage and the times that coverage is available. Atmospheric drag at low altitudes can limit mission duration. Figure 4.13 [Ref. 55: Fig. III.E-1] gives the maximum time of satellite coverage as a function of orbital altitude; Figure 4.14 [Ref. 55: Table I-1] gives the number of vehicles required for worldwide coverage more often than hourly; the lower curve of Figure 4.15 [Ref. 55: Fig. I-2] shows the limitations on orbital flight duration as a function of orbital altitude. Because the laser system requirements call for an agreed upon direction of attack, the time is effectively reduced by one half; the illustration in Figure 4.4 shows that after the satellite passes over the target, an engagement is no longer possible if the weapons platform is not in the same quadrant as the satellite. When considering the average cloud coverage in certain areas of the world, worldwide coverage is probably not practical. Figure 4.14 gives an idea of the number of vehicles required to provide worldwide timely coverage (more often than hourly). Depending on funds and the cost of each space-based laser, this timeliness would probably decrease. Recalling the times for J-SAK mission planning, a 96 hour planning horizon and 36 hour apportionment decision would provide sufficient time to maneuver a satellite into a position to influence the action. The satellite orbital parameters and time of coverage of the target area would then dictate the exact window of time for engagement. Synchronization would be accomplished by this fact since the attacking platform would know the exact time the laser would be turned on, thus eliminating the requirement for active communications. This may or may not be a desirable feature. The purpose here is to highlight the tradeoff, not make the tradeoff ourselves.

F. SUMMARY

It was never intended for this chapter to be considered a **complete** analysis of a space-based laser designator; therefore, the author cannot unequivocally conclude whether the idea is "good" or "bad". The purpose here was to show the application of the CBRS methodology to a space concept. By following the process, the analysis highlights the advantages and disadvantages of the concept. Even though a space-based laser designator would fill a void in the space mission of force application, would not violate any treaties, would help counter the use of obscurants on the battlefield, and has a sound doctrinal base, the biggest drawbacks are in the technological forecasts. The current pointing accuracy and environmental limitations, spot size and

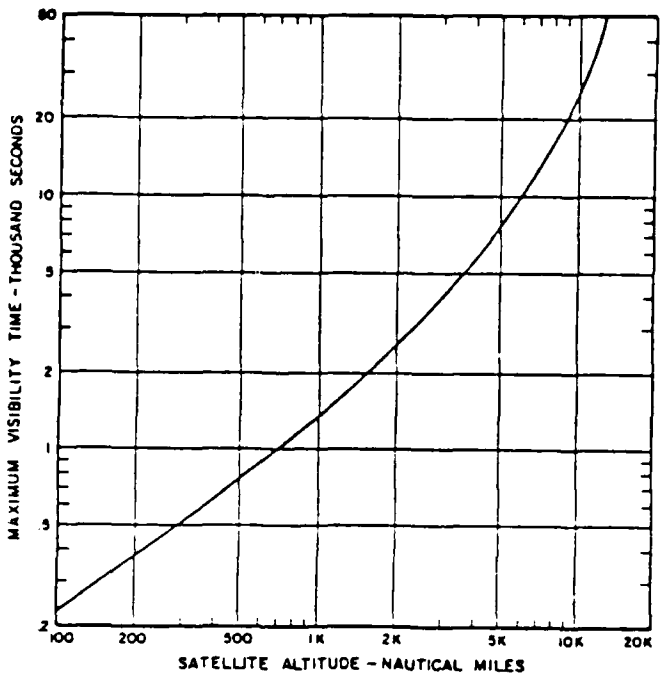

Figure 4.13 Maximum Time of Satellite Visibility.

Altitude in Nautical Miles	Number of Vehicles for Line of Sight Coverage	Number of Vehicles for a Narrow Field of View
200	16-48	40-100
1000	12-24	24-48
6000	8-16	16-32
19300	3-6	6-18

Figure 4.14 Vehicles Required for Hourly Worldwide Coverage.

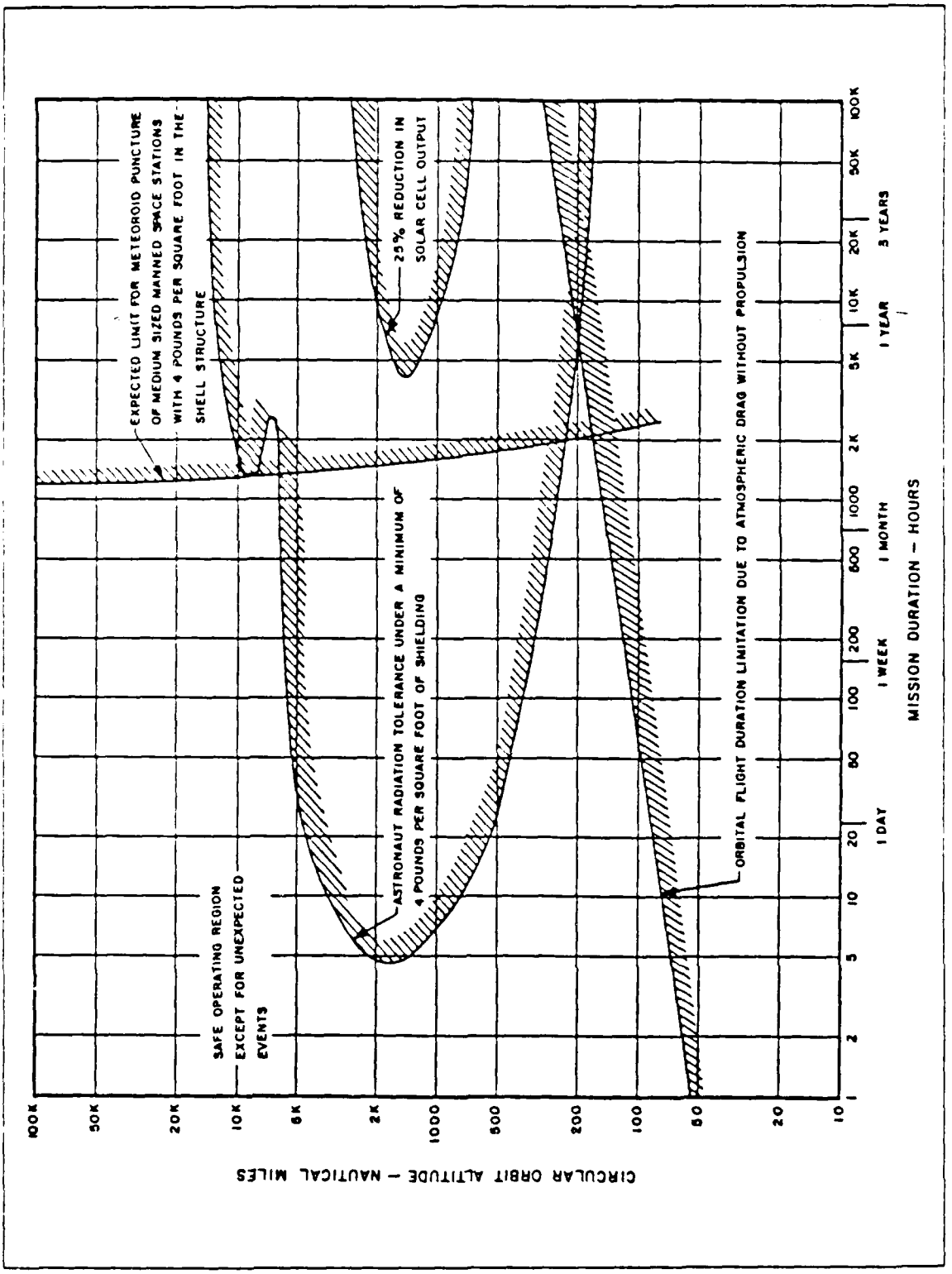

Figure 4.15 Limitations on Mission Duration and Orbital Altitude.

mirror requirements, and lack of mission timeliness appear to be "show stoppers". The area of technology, sometimes assumed to be the panacea given enough research and money, became the drawback for this specific case. There are, of course, other cases where the technology is developed and mature, but the areas of mission, historical perspective, and threat do not support the application of the technology to the military environment. All four areas provide a means to accomplish an ends: Highlight the good and bad points of a potential space system before writing an operational concept for its use. Since the operational concept drives the system specifications and materiel acquisition process, it is important that the operational concept remain consistent within the four areas. That way, engineers don't have to "paint a moving train"--designing equipment while the operational concept and requirements are being rewritten to make the space system work with other terrestrial systems.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Conclusions From Chapter I

- Windows of opportunity sometimes open which will allow superior concepts the chance of fruition; they also allow substandard concepts to be thrust forward without adequate examination. It is essential that concepts be well-defined and articulated before windows of opportunity open.
- It seems that the historical and political events of 1985 and 1986 may have opened the window for consideration of space systems which are designed to support joint tactical operations.
- The key to winning approval of Congressional funding for space systems in the future will be the articulation of joint military requirements and showing the relationship of these requirements to the accomplishment of unified missions during the Planning, Programming, and Budgeting cycle.

2. Conclusions from Chapter II

- The field of military science requires guidelines--something upon which to base its operations. Since the outcome of military operations is not deterministic, it is hard to articulate a bedrock foundation on which to base employment and acquisition decisions. It is, however, essential to attempt to articulate a foundation for placing in context how a war will be fought, how missions will be accomplished, and the interactions of the forces which will fight it. Doctrine should provide this foundation.
- The Army's Concept Based Requirements System links doctrine to military requirements, has been in use for over a decade, and has been recommended for use by the other services.
- Even where specific deficiencies are not identified, technological opportunities to strengthen mission areas should be explored.
- Terminology is important if one is to formulate and understand joint doctrine.
- The standardization of terminology is accomplished to some degree by JCS Publication 1. JCS Pub 1 may omit terms used in the service and common usage within the services may not coincide with definitions in JCS Pub 1.

3. Conclusions from Chapter III

- The services articulate fundamental principles that guide the employment of forces in different ways. Since fundamental principles may be expressed as capstone doctrine, basic doctrine, strategy, or white papers, it is important to realize what one is reading, and more importantly, what one is searching for, when interpreting and formulating future concepts in the joint and combined areas.

- The AirLand Battle and the Maritime Strategy provide the general context for joint service missions. The Joint Army and Air Force Attack of the Second Echelon and the ASUW STRIKE engagement process provide a specific context for long range engagements. The AirLand Battle and Maritime Strategy are compatible on what the Army calls the "operational" level of war. The objectives, methods, and resources used to perform deep operations and over-the-horizon operations invite opportunities for true, joint operations.

4. **Conclusions from Chapter IV**

- The idea of a Space-Based Laser Designator should not be construed to mean that the concept is nearing development or realization. It was chosen solely as a means of illustrating CBRS's method of relating doctrine to requirements for a space system.
- Joint doctrine does not exist in many areas where it is necessary. This lack of doctrine does not allow the CBRS to adequately place in context how a new space system will operate with current terrestrial systems. The example which was chosen did have a doctrinal basis springing from the 525-series pamphlet *Joint Laser Designation Procedures*.
- Concepts for new space systems must consider treaty implications if they are to be realized in a timely manner.
- Space systems have several limitations when compared to terrestrial systems when it comes to tactical warfighting. Some of these include responsiveness, area of coverage, and priority of use.
- All things are not technologically feasible or desirable. An analysis should provide a display of the advantages and disadvantages of space solutions. The decision maker or makers with the responsibility of determining the contribution expected of new systems can then decide if the idea is "good" or "bad".

B. RECOMMENDATIONS

- The Concepts Based Requirements System (CBRS) should initially be adopted by the J7 Doctrine and J8 Acquisition staffs as the integrating mechanism for relating doctrine to acquisition. It will be a good starting place on which to build.
- Terminology should continue to be standardized. The AirLand Battle and Maritime Strategy are semantically different, but substantially very similar. The J7 should provide the momentum to insure future versions of the principles outlined in both documents conform to the National Military Strategy.
- The Space-Based Laser Designator should probably not be developed at this time. Even though it would fill a void in the space mission of force application, would not violate any space treaties, would help counter the use of obscurants on the battlefield, and has a sound doctrinal base, the biggest drawbacks are in the technological forecasts. The current pointing accuracy and environmental limitations, spot size and mirror requirements, and lack of mission timeliness

appear to be "show stoppers". The conditions under which one might wish to reexamine this concept would include the ability of the SDI to meet microradian pointing accuracy, a drastic reduction in the cost of mirrors, a drastic reduction in launch costs, or a technological breakthrough which allowed a laser beam to penetrate clouds.

LIST OF REFERENCES

1. Craig, T.L., Major General, Deputy Chief of Staff for Requirements, Tactical Air Command, U.S. Air Force, *Tactical Operations and Space Applications*, Proceedings of the 46th Symposium of the Avionics Panel held at NASA Langley Research Center, Advisory Group for Aerospace Research and Development (AGARD), North Atlantic Treaty Organization, Seine, France, October 1984.

2. Rand Arroyo Center, *The Army's Role in Space, Arroyo Center Annual Report - Selected Research Summaries, Fiscal Year 1985*, February 1986.

3. Department of the Army, *Army Space Initiatives Study Report, Volume I*, Fort Leavenworth, Kansas, 14 May 1986.

4. Department of the Army, *Army Space Policy Letter*, Washington, D.C., 5 June 1985.

5. Fletcher, James C., *Statement by Dr. James C. Fletcher, NASA Administrator, Press Briefing*, National Aeronautics and Space Administration, 3 October 1986.

6. Covault, Craig, "New Defense Space Policy Supports Manned Flight Role", *Aviation Week & Space Technology*, 8 December 1986.

7. Staff Report to the Committee on Armed Services United States Senate, *Defense Organization: The Need for Change*, U.S. Government Printing Office, Washington, D.C., 16 October 1985.

8. United States Senate Committee on Armed Services, *Press Release--Goldwater and Nunn Announce Committee Approval of Defense Reorganization Bill*, Washington, D.C., 6 March 1986.

9. Maze, Rick, "Nunn Plans to Change Orientation of Senate Armed Services Panels", *Army Times*, 29 December 1986.

10. Sovereign, Michael G., *Classroom Lecture in C3 Policies and Programs*, Postgraduate School, Monterey, California, January 1987.

11. Goldwater, Barry, "OSD: Lack of Mission [illegible] Problem", on 4 October 1985, *Armed Forces Journal [illegible]*.

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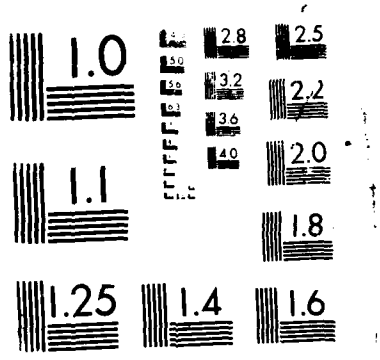

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12. United States Army Training and Doctrine Command (TRADOC), *TRADOC Pamphlet 11-8, Studies and Analysis Handbook*, Fort Monroe, Virginia, 19 July 1985.

13. Wright, Donald A., Captain, USN and Saddler, David L., Lieutenant Colonel, USMC, *Establishing the LHX ROC*, Industrial College of the Armed Forces, Washington, D.C., May 1986.

14. United States Army Training and Doctrine Command (TRADOC), *TRADOC Regulation 11-7, TRADOC Doctrinal and Training Literature Programs*, Fort Monroe, Virginia, 3 January 1986.

15. Wohl, Joseph G., "Force Management Decision Requirements for Air Force Tactical Command and Control", *IEEE Transactions on Systems, Man and Cybernetics*, 1981.

16. Department of the Army, *FM 100-5 Operations*, Washington, D.C., 5 May 1986.

17. United States Army Training and Doctrine Command (TRADOC), *AirLand Battle 2000 (1982 Version with Functional Areas)*, Fort Monroe, Virginia, 10 August 1982.

18. United States Army Training and Doctrine Command (TRADOC), *TRADOC Pam 34-1 Doctrinal Terms: Doctrine, Tactics, Techniques, and Procedures*, Fort Monroe, Virginia, 27 July 1984.

19. Department of Defense, *JCS Publication 1, Dictionary of Military and Associated Terms*, The Joint Chiefs of Staff, Washington, D.C., 1 January 1986.

20. Matthews, Lloyd J., Colonel (Retired), "Operationalese Mania", *Army Magazine*, February 1987.

21. Latham, Donald C., Assistant Secretary of Defense for C3I, Remarks made at the American Institute of Astronautics and Aeronautics *(AIAA) 3rd National C3I Policy Issues and Answers Conference*, Naval Postgraduate School, Monterey, California, 5 February 1987.

22. United States Army Materiel Command (AMC) and Training and Doctrine Command (TRADOC), *DARCOM/TRADOC Pamphlet 70-2, Materiel Acquisition Handbook*, Alexandria and Fort Monroe, Virginia, 20 January 1984.

23. United States Army Training and Doctrine Command, *TRADOC Regulation 11-8, Studies Under AR 5-5*, Fort Monroe, Virginia, 29 March 1985.

24. Melich, Michael E. and Sovereign, Michael G., *Requirements in Department of Defense Acquisition*, Naval Postgraduate School, Monterey, California, 28 February 1986.

25. Department of Defense, *System Engineering Management Guide*, Defense Systems Management College, Fort Belvoir, Virginia, 3 October 1983.

26. Levis, Alexander H., *Modeling and Measuring Effectiveness of C3 Systems*, Laboratory for Information and Decision Systems, Massachusetts Institute of Technology (MIT), Cambridge, Massachusetts, September 1986.

27. Sweet, Ricki, *Modular Command and Control Evaluation Structure (MCES): Applications of and Expansion to C3 Architectural Evaluation*, Naval Postgraduate School, Monterey, California, September 1986.

28. Hatch, William J., Major, U.S. Army, *AirLand Battle Doctrine: The Debate Continues*, School of Advanced Military Studies, Fort Leavenworth, Kansas, March 1985.

29. Olson, Walter E., Colonel, USA, *AirLand Battle Execution--Some Implications of Deep Attack*, U.S. Army War College, Carlisle Barracks, Pennsylvania, May 1984.

30. Interview with General Larry D. Webb, Air Force Chief of Staff, *Airman Magazine*, November 1986.

31. Trost, Carlisle A. H., Admiral, U.S. Navy, "Looking Beyond the Maritime Strategy", *Proceedings*, U.S. Naval Institute, Annapolis, Maryland, January 1987.

32. Barber, James A. Jr., "From the Executive Director", *Proceedings*, U.S. Naval Institute, Annapolis, Maryland, January 1986.

33. Caldwell, Thomas A., III, Colonel, U.S. Air Force, *Command Structure for Theater Warfare--The Quest for Unity of Command*, Air University Press, Maxwell Air Force Base, Alabama, September 1984.

34. Redden, Joseph J., Lieutenant Colonel, U.S. Air Force, *AirLand Battle--The Global Doctrine?*, U.S. Army War College, Carlisle Barracks, Pennsylvania, 18 May 1983.

35. Harned, Glenn M., Major, U.S. Army, "The Maritime Strategy", Letter published in *Proceedings*, U.S. Naval Institute, Annapolis, Maryland, February 1986.

36. Martin, Terry, Captain, U.S. Marine Corps, *Command, Control, and Communications Missions and Organization: A Primer*, Naval Postgraduate School, Monterey, California, March 1984.

37. Maze, Rick, "Plan Would Exchange Readiness Command for Special Operations", *Army Times*, 2 February 1987.

38. Budahn, P.J., "Transportation Command to Become Nation's 8th Unified Activity April 15", *Army Times*, 30 March 1987.

39. Sendak, Theodore T., Lieutenant Colonel, U.S. Army, *Army Role in Space: Design of an Army Corps Incorporating Space Capabilities*, U.S. Army War College, Carlisle Barracks, Pennsylvania, 31 May 1986.

40. Lawson, Joel S., *The Role of Time in a Command Control System*, Naval Postgraduate School, Monterey, California, undated.

41. United States Readiness Command, United States Army Training and Doctrine Command, and United States Air Force Tactical Air Command, *Operational Concept for Joint Attack of the Second Echelon (J-SAK)*, U.S. Readiness Command, MacDill Air Force Base, Florida, 13 December 1982.

42. United States Readiness Command, United States Army Training and Doctrine Command, and United States Air Force Tactical Air Command, *General Operating Procedures for Joint Attack of the Second Echelon (J-SAK)*, U.S. Readiness Command, MacDill Air Force Base, Florida, 31 December 1984.

43. United States Army Training and Doctrine Command (TRADOC), *TRADOC Pamphlet 525-34, Operational Concept for Special Operating Forces*, Fort Monroe, Virginia, 26 July 1984.

44. United States Readiness Command and others, *Joint Laser Designation Procedures*, MacDill Air Force Base, Florida, 11 December 1985.

45. Swartz, Peter M., Captain, U.S. Navy, "The Maritime Strategy in Review", *Proceedings*, U.S. Naval Institute, Annapolis, Maryland, February, 1987.

46. Watkins, James D., Admiral, U.S. Navy, "The Maritime Strategy", *Proceedings*, U.S. Naval Institute, Annapolis, Maryland, January 1986.

47. Melich, Michael E. and others, *Center for Naval Analysis Research Contribution: Engage Hostile Surface Units with Surface Units*, Center for Naval Analysis, 1975.

48. Froggett, S.J., Commander, U.S. Navy, "Tomahawk's Role", *Proceedings*, U.S. Naval Institute, Annapolis, Maryland, February 1987.

49. Schultz, James B., "Cruise Missile Deployment Marked by System Upgrades and Operational Tests", *Defense Electronics*, EW Communications, Inc., May 1984.

50. Bradley, John E., Commander, U.S. Navy, *The AirLand Battle Doctrine and the Maritime Strategy: A Mixed Marriage?*, U.S. Army War College, Carlisle Barracks, Pennsylvania, 7 April 1986.

51. Orr, George E., Major, U.S. Air Force, *Combat Operations C3I: Fundamentals and Interactions*, Air University Press, Maxwell Air Force Base, Alabama, July 1983.

52. Fuhs, Allen E., "Class Notes on Military Space Missions", *SS2001--Military Operations in Space*, Naval Postgraduate School, Monterey, California, Fall 1985.

53. United States Congress, Office of Technology Assessment, *Anti-Satellite Weapons, Countermeasures, and Arms Control*, U.S. Government Printing Office, September 1985.

54. Abraham, Fred L. and others, *Army Role in Space: A Study of Missions*, U.S. Army War College, Carlisle Barracks, Pennsylvania, 13 May 1985.

55. United States Air Force, *Space Planners Guide*, Air Force Systems Command, 1 July 1965.

56. Digby, James, *Precision-Guided Weapons*, The International Institute for Strategic Studies, London, England, Summer, 1975.

57. National Aeronautics and Space Administration, *Space Laser Power Transmission System Studies*, Proceedings of a Symposium held at NASA Langley Research Center, Hampton, Virginia, 14-15 October 1981.

58. Hecht, Jeff, *Beam Weapons--The Next Arms Race*, Plenum Press, New York and London, February 1985.

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